

The Dock & Harbour Authority

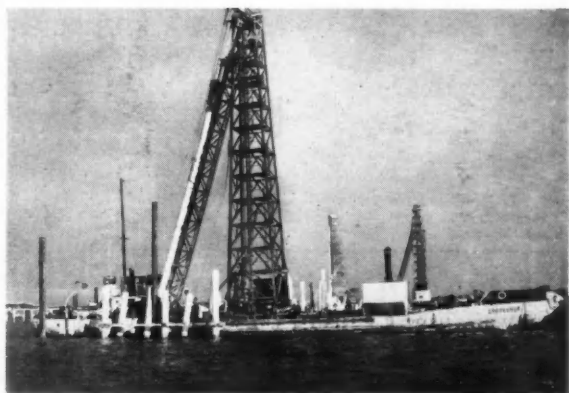
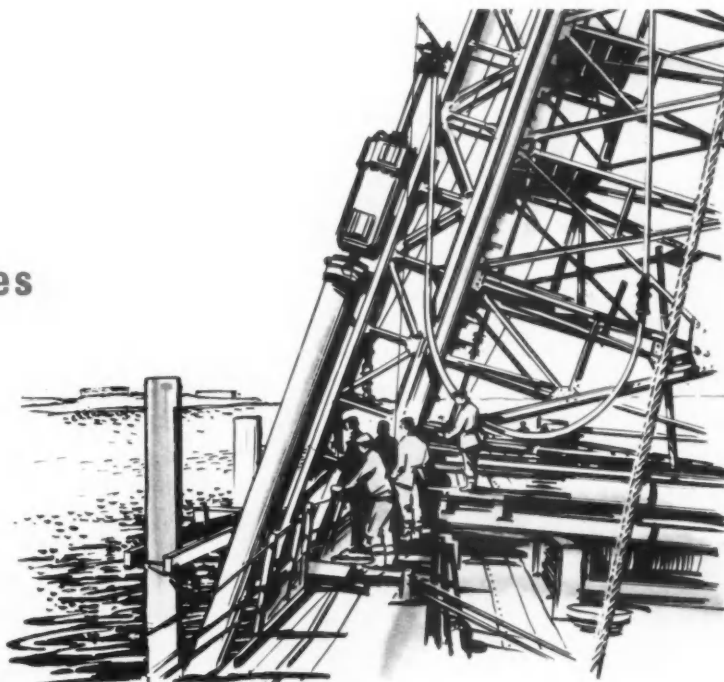
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JUNE, 1960

Monthly 2s. 6d.

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**B.S.P. pile hammers
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*m.v. "GROSVENOR" showing the pendulum leaders
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Length (metres)	10	12	14	17	19	*Percentage of soil in mixture	10-20	10-20	10-20	10-20	10-20
Width (metres)	4	4,50	5	6	7	Soil production at max. height and distance cbm/h.	30-60	40-80	62-124	90-180	120-240
Depth (metres)	1,50	1,50	1,80	1,80	1,80	Diameter suction pipe (cm.)	20	25	30	35	40
Draft app. (metres)	0,65	0,70	0,80	0,80	0,75	Diameter discharge pipe (cm.)	17,5	20	25	30	35
Max. cutter depth (metres)	3,50	5	6	7	8	Total Diesel power H.P.	85	155	259	374	487
Max. distance of discharge (metres)	250	500	750	900	1000	* Note that the percentage of soil in the mixture depends on the nature of the soil and consequently the soil production will vary between the given figures.					
Max. height of discharge at max. distance (metres)	3	3	3	3	3						
Mixture production at max. height and distance cbm/h.	300	400	620	900	1200						

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The Dock & Harbour Authority

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Editorial Notes

The Port of Los Angeles

We publish in this issue an instructive article on the organisation, administration and development of the Port of Los Angeles, a public facility which has grown up in the last fifty years or so, with little in the way of natural physical advantages, to become what is probably the largest man-made harbour in the world. The phenomenal growth of the City of Los Angeles (according to the last census in 1950, the fourth city of the United States) has become proverbial. During and since the war it and its hinterland has been a centre of great industrial expansion and all the time it is becoming more dependent on seaborne traffic for its raw materials and as an outlet for finished products in order to sustain a rapidly extending economy.

As is usual in the United States of America, the administration of the Los Angeles sea terminal is a creature of political subdivision, the small Board of Commissioners being appointed for a fixed term by the City Council. Again, as is usual once an organisation attains a certain size, the Board does not concern itself directly with port operations but confines its activities in the main to providing, developing and maintaining facilities for others to use and ensuring that they are effectively utilised for the common good by private operators. The principal sources of revenue required for administration, upkeep and betterment consist, therefore, of dockage, wharfage and rents, assessed according to the practice, generally adopted in the American shipping industry, that the vessel's responsibility is presumed to begin at point of rest on inbound cargo and to end at point of rest on inbound cargo.

The success of the administration can be judged by the history of the undertaking which has been one of continuously developing custom and growth of facilities and, though mention is made of the great financial burden which this has entailed, it would appear that the port is now substantially free of debt and, after servicing outstanding loans and maintaining its fixed assets, it is able to finance its necessary development almost entirely out of current operating surpluses. Until comparatively recently, however, wharfing operations *per se* proved to be highly unremunerative, in common with most of the major Californian terminals which relied for their solvency on the multiple nature of their business, such as real estate development and oil. But some 20 years ago the ten principal ocean terminals (Los Angeles being by far the largest) formed themselves into a California Association of Port Authorities and agreed to adopt a common basis of costing their operations so that tariff structure and segregation of charges (subject to the approval of the United States Maritime Commission, who subsequently initiated a full-scale rates study)

might be put on a sound and realistic footing. The objects and purposes of the Association are sufficiently interesting and suggestive for us to reproduce them here: "That, in consideration of the benefits to be severally and collectively derived from this agreement, the parties hereto hereby associate themselves in an association to be known as the 'California Association of Port Authorities' hereinafter referred to as the 'Association,' to promote fair and honorable business practices among those engaged in the marine terminal industry, to more adequately serve the interests of the shipping public at their terminals in ports in the State of California and to establish and maintain just and reasonable, and, as far as practicable, uniform terminal rates, charges, classifications, rules, regulations and practices at such terminals for or in connection with interstate and foreign waterborne traffic, provided that it is recognised that each port or terminal may have a different situation and the term 'uniform' shall not necessarily be construed to mean identical, and it is understood that all matters involved herein shall be worked out in a spirit of bona fide effort to accomplish an arrangement that will give no one an undue advantage, taking into consideration all competitive conditions, and to co-operate with port authorities and marine terminal operators of other districts either individually or through their associations, to the end that the purposes set forth above may be achieved as widely as possible."

The clear purpose of the agreement was to avoid the economic consequences of undue development and excessive competition in essential services to a point where the available commerce could not sustain them. It is not known to what extent the final recommendations have been translated into action at the individual terminals but the article now published reveals that the Port of Los Angeles, at any rate, has prospered and developed subsequently to a remarkable degree. The preference for marginal wharves with wide aprons (though these often take the form of pier-quays, in contradistinction from the finger piers prevalent on the eastern seaboard) and the capacity for developing them in depth, will be observed. The growth of road transport has necessitated wide assembly spaces for cargo if congestion is to be avoided, particularly so now that container and "roll-on, roll-off" traffic is gaining in popularity—a circumstance which other developers would do well to note. It would appear, too, (though the photographs accompanying this article are not absolutely conclusive on this point) that the wider wharf aprons now found desirable have caused the abandonment of the "house falls" linkage of union purchase, so long a feature of American practice.

Conference on Safety of Life at Sea

The Safety of Life at Sea Conference, which opened in London on May 17th, is due to finish on June 17th and this is a convenient stage to review what has been accomplished to date. There has been what must have seemed to the onlooker interminable discussion, but the importance of wording can be seen in the result of the advisory opinion given by The International Court of Justice, which has just ruled that the maritime safety committee of the Inter-Governmental Maritime Consultative Organisation (IMCO) was incorrectly constituted in not including Liberia and Panama. As the conference is being held under the aegis of IMCO, a note on the decision may be of interest.

At the beginning of the year IMCO asked the World Court to give an advisory opinion on whether the Maritime Safety Committee had been constituted in accordance with the convention for the establishment of the organisation. This committee has to consist of fourteen members, of whom eight shall be the largest ship-owning nations. Panama and Liberia contended that, on the basis of gross registered tonnage, they should be included in this category and should therefore have been elected members of the committee.

The Court in its ruling said it shared the general view that when reference was made to "shipping countries" the reference was to registered tonnage only.

Although this was an advisory opinion only and does not affect the general work of IMCO, it does illustrate the importance of strict definition and is probably a justification for the amount of time spent on language which has eventually to be incorporated in a convention.

Recommendations of three committees which had completed their work, were submitted at a plenary session of the conference. The committees are those which have had under consideration grain, ore and other bulk cargo; nuclear ships; and dangerous goods. The safety of nuclear-powered ships saw the development of the first major controversy during the conference, due to the attitude of the Soviet delegate, and in the end the President of the conference, Sir Gilmour Jenkins, decided to defer the entire contents of the report of the committee until the next plenary session.

An extension of radio regulations to cargo ships between 300 and 500 gross tons has been approved by the nineteen-member Radio Committee. This amendment, and any others recommended by the committee, will go to the conference in plenary session.

It will thus be seen that the conference has accomplished a good deal of work—for this is only a brief outline of its activities.

Oil Tanker Accommodation at Tranmere

The new oil terminal at Tranmere, Birkenhead, which came into operation early this month, marks a further stage in the development of Merseyside as one of the major ports in the United Kingdom.

Details of this project, which was jointly sponsored by the Mersey Docks and Harbour Board and the Shell Refining Company Ltd., were published in the November 1959 issue of this Journal, and brief reference was made to the many unusual and complicated engineering problems involved.

The terminal consists of two floating stages connected by a large jetty to the land, where there are storage tanks to receive the incoming crude oil cargoes. Each of the floating stages is 366-ft. long and 62-ft. wide, and is moored by four 150-ft. booms to pillars set in the river bed; these have been specially designed to absorb the impact of the ship. They will also allow the stages to rise and fall with the tide, which often varies to an extent of 30-ft. These two stages are each capable of accepting a 65,000-ton-dwt. tanker, and it will be possible to accommodate even

larger vessels on a restricted draught.

The deck structure on each stage incorporates deep longitudinal girders supported by a series of individually-removable transverse rectangular steel pontoons. Each berthing face is protected by sprung fender beams faced with rubber cylinders. The free-board will be about 8-ft. 6-in., and the total displacement almost 2,000 tons.

At present only one of the two floating stages is in operation; the second is scheduled to come into service next month when the simultaneous discharge of oil from two ships will total 8,000 tons per hour. It is anticipated that, initially, the terminal will deal with about 5 million tons of oil a year.

Safer Navigation in New York Harbour

A new system to ensure safer navigation in the New York harbour area in periods of poor visibility will be put into operation in a few weeks by the Maritime Association of the Port of New York. The system which is now being tested, incorporates a network of observation posts in strategic positions in the harbour.

The project has been in the planning stage for months and is said to have been developed following the collision between the Cunard liner *Queen Elizabeth* and the U.S. cargo ship *American Hunter* last July. The two ships collided in dense fog in the lower bay.

Under the scheme, the pilots of ships will be able to obtain by radio-telephone from the pilot boat stationed off the Ambrose Light Vessel up-to-date visibility information gathered at four points in the harbour. Permission has been obtained from the U.S. Coast Guard for a direct radio-telephone circuit with the manned lighthouse at Romer Shoal. In addition, approval for the system has been obtained from the Federal Communications Commission.

New Lighthouse for Sombrero

The lighthouse on Sombrero, a barren, waterless rock in the Virgin Islands group of the West Indies, is to be replaced at a cost of nearly £100,000. Contract for the work of supply and construction at the site has been awarded to a British company who will provide a new revolving apparatus and lantern, and erect a 125-ft. aluminium metallised steel tower of hurricane-proof design. They also will be responsible for the civil engineering site works involving elaborate foundations and construction in reinforced concrete, and the dismantling of the existing tower.

Sombrero is one of ten Imperial lighthouses maintained by the Ministry of Transport. It is operated by the St. Kitts Government on behalf of the Ministry, whose inspector at Nassau visits the lighthouse from time to time. The contract has been placed by Trinity House.

The Missions to Seamen

The annual report of the Missions to Seamen, surveying last year's work in all the ports throughout the world in which the Society is active, emphasises the world-wide nature of the Society. Canada, South America, the West Indies, the African coast, the oil and cargo ports of the Middle East, the ports of the Far East from India and Colombo as far as Japan, and the ministry to seamen in Australia, New Zealand and Fiji all find mention as do the European Continental ports and the ports in the British Isles where chaplains are finding increasing opportunities to care for seamen of other races and nations—of all colours and from both sides of the "iron curtain."

The report shows a deficit for the year of just over £1,500, and it is explained that, not only in order to avoid a recurrence of this deficit, but also to replenish reserves and to enable the Missions to undertake new work, it will be necessary to raise an extra £24,000 in 1960.

It is to be hoped that there will be a generous response to this appeal for funds to assist this beneficial work.

The Port of Los Angeles

Review of its Growth and Development

By Adm. EDWARD V. DOCKWEILER
(Chief Engineer to the Board of Harbour Commissioners)

History

The Port of Los Angeles was discovered in 1541 when Captain Juan Rodriguez Cabrillo landed in San Pedro Bay and anchored his ships in the lee of Point Fermin. Very little port development was accomplished during the next two and one-half centuries as the bay was not sufficiently well protected as a natural harbour to accommodate shipping operations.

The first commercial shipping started in the beginning of the 18th century, and it was not until the middle of that century that the City of Los Angeles, located about 20 miles inland and to the north of San Pedro Bay, was incorporated. In 1869 the first railroad in the State of California was constructed from the Plaza in the City of Los Angeles to the harbor in San Pedro Bay and within 11 years there was public demand for the construction of a larger harbor to serve this growing southwestern frontier area of the United States.

Early port development was accomplished by private interests but, as this development was exceedingly expensive, harbor expansion did not take place fast enough to meet the demand of the community. In 1907 the City of Los Angeles created a Board of Harbor Commissioners to administer the construction and operation of municipal port facilities to be constructed by the City. From this time on, public monies were made available for the development of this harbor and today the City, through its Harbor Commission, administers all of the facilities of the Port of Los Angeles.

This Board has continued to develop the harbor from an original state of tide flats and small estuaries to its present status of one of the largest man-made harbors in existence. Dredging and bulkheading were required to develop virtually every facility in the port.

Breakwaters

In 1899 the Outer Harbor breakwater was started with funds provided by the United States Government. The first breakwater unit, about 2.11 miles long extending in a southerly direction from Point Fermin, was faced on the ocean side with rock weighing eight tons or more to insure stability from

the rough seas occurring in this area. It is an all rock construction and located in about 60 feet of water. While occasionally Pacific storms cause waves of sufficient height to cover the breakwater, little if any damage has occurred to the structure and the harbor waters are generally quiet.

By 1930, development of the harbor progressed to the point where an additional breakwater was required, and the construction of another nine miles was started. The extension of this breakwater was built on a sand and clay fill about 30 feet deep and with the seaward slop at 1 on 2 protected by riprap, the lee side being made on a 1 on 1½ slope. This type of construction has been satisfactory and, of course, proved to be more economical than the first breakwater

The first marginal wharf construction was completed in 1914 and coincided with the opening of the Panama Canal. Berths 56 to 60 in the Outer Harbor and Berths 159 to 160 in the Inner Harbor were the facilities that initiated the development of this harbor out of the existing sloughs and tide flats of the San Pedro Bay. Nine years after completion of these facilities the commercial tonnage of Port of Los Angeles exceeded all other western ports, a leadership which has been maintained without interruption to the present day.

Other construction followed rapidly in a more or less continuous manner except for the interruption of World Wars I and II.

In the early 20's all existing channels in the harbor were dredged to a minimum of 35

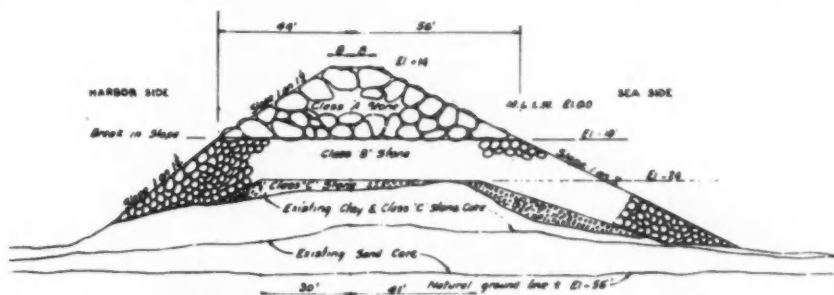


Fig. 1. Typical cross-section of the 8,650-ft. Breakwater.

constructed completely of granite and sandstone. Details of the breakwater extension are shown in (Fig. 1).

Port Development

The U.S. Corps of Engineers established pierhead lines for all of the proposed harbor development in 1908, and construction has followed this development with few modifications.

Dredging was required to construct all of the existing port facilities, the original water depth prior to development being of the order of three to twelve feet with sand shoals protruding above low water line in many areas. Dredging of the main channel was first accomplished to a depth of about 25 feet which was sufficient to accommodate all the ships in the Pacific Ocean trade at that time.

feet below mean low water, and this depth has been maintained throughout the harbor with the exception of a channel from the breakwater entrance to Berths 45 to 47 where there is an oil loading facility, with an unloading capacity of 35,000 barrels per hour, to accommodate the new supertankers. This channel is 46 to 48 feet deep.

Wharf Construction

Unlike many other ports which were constructed within large natural bodies of protected water permitting the construction of piers extending into deep water bays, this type of structure could not be utilized where water-side development was restricted by inadequate water depth. Hence, the water front is lined with wharves of the marginal type. While this type of wharf structure was dictated by the harbor's topography, it is an

The Port of Los Angeles—continued

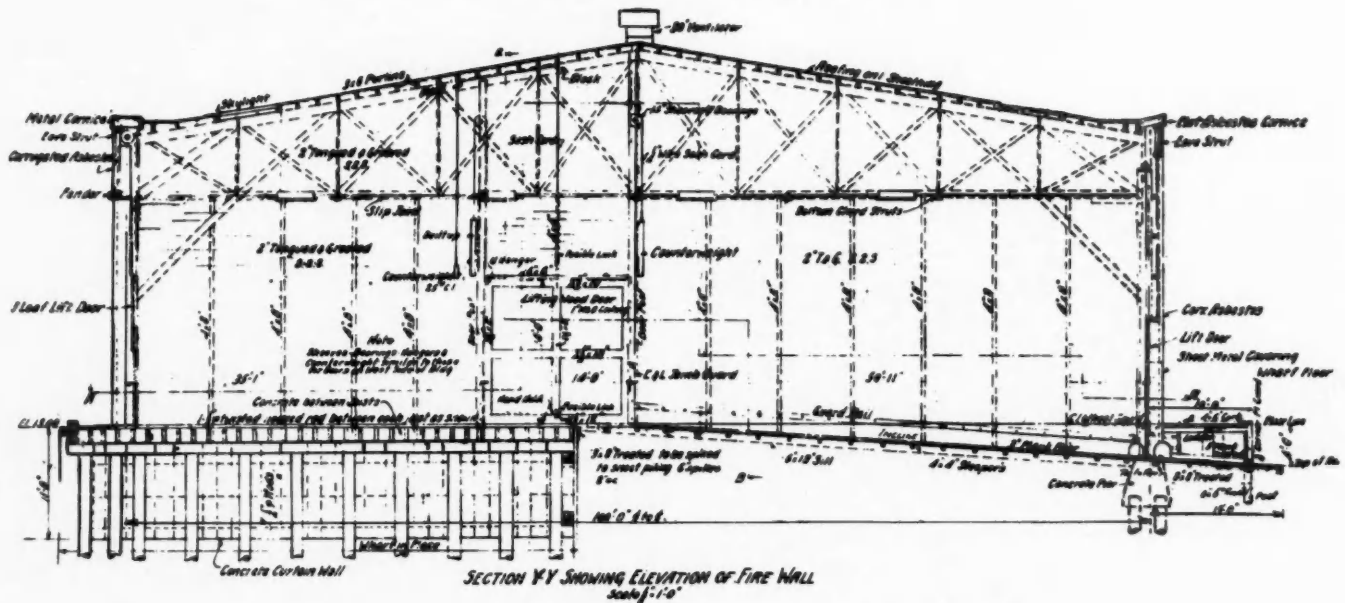


Fig. 2. Typical cross-section of wharf and transit shed constructed in 1914.

asset to modernization of facilities as well as the construction of new facilities permitting ever larger terminal size to accommodate large modern cargo vessels. Wharf aprons and transit sheds can be widened and terminal backland areas can be expanded to accommodate open cargo storage and facilitate land transportation. Also, the advent of modern motorized handling equipment makes this type of development the most

petroleum refining plants be discontinued. Since that time, water pollution has diminished and marine organisms have populated the harbor waters causing the rate of timber pile deterioration to increase to the extent that it is no longer practical to utilize creosoted timber piles in wharf construction. Replacement and maintenance work is being accomplished continuously on a basis of replacement of timber piles with reinforced

Although creosoted Douglas fir piles were first used in 1910, precast concrete piles were introduced in the Outer Harbor wharf construction in 1913, and those concrete piles which were properly constructed are providing satisfactory service today.

In the period from 1919 to 1923 hollow gunite piles were first used and were constructed in a vertical position thence transferred to the pile driver and positioned while maintaining their vertical orientation. It was believed necessary to handle these piles vertically at all times to prevent cracking which might cause early pile failure. Adaptations of the hollow gunite concrete piles were manufactured in the early 1920's but these piles were constructed as a solid pile using gunite or shot cret.

Another development utilizing an ordinary precast concrete pile was to treat the pile in a bath of molten asphalt using the vacuum pressure process at approximately 250°F. resulting in a penetration of from $\frac{1}{2}$ to $1\frac{1}{2}$ inches. To prevent transverse cracking during pile treatment, the temperature change was controlled so as not to exceed 5°F. per hour. This procedure resulted in no pile cracking during the high temperatures required by the asphalt treatment. Pressure during treatment was about 150 PSI. These piles have given very excellent service for the past 35 years.

Recent wharf design provides for the use of prestressed, precast concrete piles, and the ground slope is stabilised at about $1\frac{1}{2}$ to 1 as shown in (Fig. 3). The wharf deck is concrete with an asphaltic concrete wearing surface. This change in design has effected economies in wharf construction as well as creating a minimum of wharf maintenance and a substantial improvement in operating efficiency.

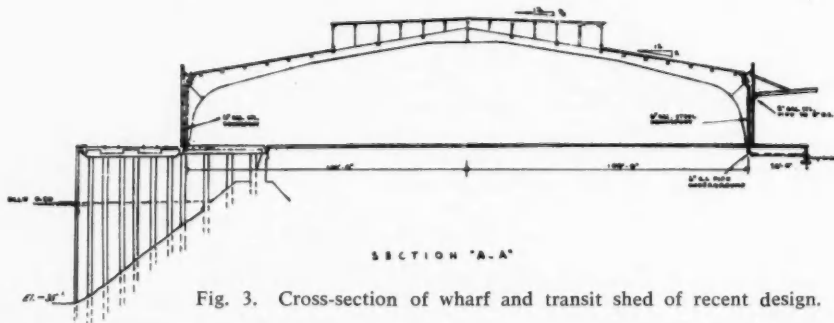


Fig. 3. Cross-section of wharf and transit shed of recent design.

efficient for terminal operation.

Due to the location of petroleum refineries in the immediate vicinity of the port, waste discharges from these operations into the harbor waters caused a semi-polluted condition in which the oxygen content was approximately one-half to two parts per million. In this environment, marine borers were non-existent and deterioration of creosoted timber piles was a minimum. This permitted the use of timber wharf construction with little or no maintenance for periods of 35 to 40 years and accounts for the large number of timber pile supported wharfs in this port. In 1948 other government agencies, including the State of California, required that discharges into the port waters from

concrete piles that are not subject to the attack of marine organisms.

(Fig. 2) is a drawing of a typical cross section of the type of wharves and transit sheds originally built in 1914. The wharf is an all timber construction, including a timber bulkhead and wharf surface, except for the concrete fire curtain wall. The five foot apron wharf on the waterside of the transit shed is sufficiently narrow as to permit the discharge of cargo directly into the transit shed area, a desirable condition at the time of this construction. The wharf surface was later covered with asphaltic concrete thus providing a more satisfactory wearing surface for both steel-rimmed and rubber-tired vehicles.

The Port of Los Angeles—continued

Shed Designs

Again referring to (Fig. 2), the first shed was 100 feet wide utilizing timber frame siding and roof sheathing with an overlay of asphalt and roofing paper. A ten-foot loading platform on the landside was an integral

built-up asphalt and paper roof was retained.

The present transit shed design as shown in (Fig. 3) consists of a rigid steel clear span frame, pin connected at the foundations and utilizing tilt-up concrete side walls and timber roof sheathing with built-up asphalt

widened to 20 feet with a canopy added to cover this area. This facility will accommodate the larger volume of cargo handled by present ships in a most economical manner.

(Fig. 4) is a photograph of one of the new type of transit shed under construction. This shed is 200 feet wide and 1008 feet long. The clear span rigid frames, reinforced concrete tilt-up walls and roof framing are clearly shown. Typical of all of the terminal facilities are the two rail tracks of the high line on the apron wharf. Two low line rail tracks adjacent to the land side loading platform will also be placed before the completion of the shed. (Fig. 5) is a picture of the same facility virtually completed and ready for occupancy by the shipping agent, and (Fig. 6) is an interior view of the transit shed showing the unobstructed cargo space and center aisle access to all of the stored cargo. Windows in the double monitor provide ample light for normal daytime operations. This facility is of ample size to accommodate the largest cargo ships presently in use and at the same time, is easily adaptable to virtually any type of existing or newly developed cargo handling equipment.

Special Facilities

The Port operates a ferry system across the main channel, from Berth 84 to Berth 234, consisting of two ferry boats to accommodate passenger, passenger car, and truck traffic. It is expected that this service will be eliminated in about two years after the Division of Highways of the State of California has completed a high-level bridge to Terminal Island to be constructed in the same vicinity. Clearance underneath this bridge is to be 186 feet.

The Port also operates a bascule-type bridge on Ford Avenue at the east end of the harbor but it is planned to replace this with a solid fill causeway in the near future. This facility not only accommodates automobile and truck traffic but provides for the only rail access to Terminal Island to serve all of the shipping terminals and in addition, the U.S. Naval Shipyard on the southeast portion of the island as well as the Edison Company steam-electric generating plant.

Other special facilities constructed by the Port for use by terminal operators are the petroleum wharves for the loading and unloading of bulk petroleum products, latex and vegetable oil handling facilities, oil tank farms, and a grain terminal. The petroleum wharf at Berths 45 to 47 was completed in 1959 to serve the newly constructed super-tankers. These ships are about 900 feet long with a draft of 42 feet and thus required dredging the channel from the breakwater entrance to Berths 45 to 47 to a minimum of 46 feet below low water. The wharf pumping units and the associated tank farm located on the backland about one mile from the



Fig. 4. New transit shed under construction.

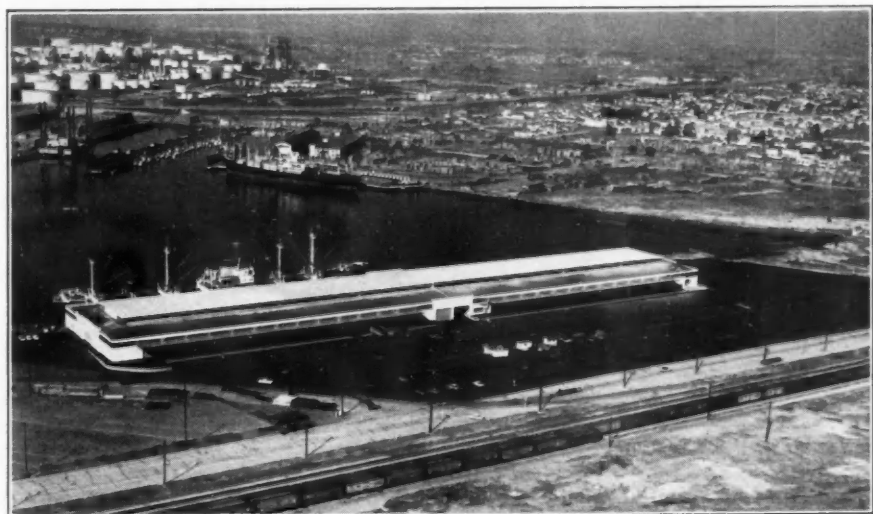


Fig. 5. View of completed transit shed.

part of the shed construction. Timber framing was bolted wood trussed on wood columns and girts.

In 1922 steel frame with sheet metal siding was used in transit shed construction though the use of wood roof joists, sheathing and

roof supported by steel purlins. The minimum apron wharf on all of the existing harbor terminals is 35 feet. The uncovered apron wharf on the new shed construction has been increased to 50 feet on the water side and the landside loading platform

The Port of Los Angeles—continued

petroleum wharf have an unloading rate of about 35,000 barrels per hour.

Land Transportation

From the arrival of the first brig in the Port of Los Angeles in 1805 to the present day, land transportation and access to the port has been a major problem as most of the population and the commercial area of Los Angeles is located about 20 to 50 miles inland from the harbor. In 1869 the first railroad from Los Angeles to the port was completed and beginning in 1923, the development of an adequate and proper land transportation system has required the expenditure of large sums of money. Today there are three transcontinental railroads serving the port and many miles of streets, highways and expressways to accommodate the collection and distribution of water-borne cargoes. Well over one-half of the cargo passing through the port is transported by trucks, thus requiring an extensive street and highway system to service the port facilities.

It is the responsibility of government agencies other than the Port to finance, construct and maintain this highway system. The three privately owned railroads serving the port have joined with the Port in the creation of the Harbor Belt Line Railroad, organized in 1929 to operate only within the Harbor District. This operating organization has and is providing very satisfactory service in the port area.

Operation and Financing

The Board of Harbor Commissioners of the City of Los Angeles is a political entity of the City, the five Commissioners being appointed by the Mayor and confirmed by the City Council for a term of five years. The position of Commissioner is one of civic service and the Commissioners serve without pay as this responsibility does not require their full time and attention. A permanent full-time employed staff is composed of a General Manager and his department heads of Engineering, Operations, Real Estate Management, Port Security, Public Relations, Accounting and Legal, and their necessary supporting personnel.

The Port of Los Angeles builds and owns all of its facilities including the land, buildings, wharves, etc., and leases them to shipping companies, which hire private stevedoring firms to accomplish their loading and unloading operations. Under this procedure the port is responsible only for the facility and its maintenance, while the shipping company or its agent is responsible for the cargo handling operation.

After the State of California granted to the City of Los Angeles all of their former rights and titles to tide and submerged lands with the consolidated city, the City in 1913 approved a \$3,000,000 bond issue to initiate the development of the harbor. To date,

about \$155,000,000 of City and Federal funds have been invested in this largest of man-made harbors. Of this amount \$50,000,000 was expended by the Federal Government in dredging and breakwater construction and the Los Angeles citizens have provided \$29,000,000 in harbor bonds to accomplish the continuing harbor improvements. Only about \$4,000,000 of this total investment remains to be paid. The rest of the money has come out of the harbor revenues and the Port is, and has been for some time, a financially self-sustaining operation. The gross revenues derived from the operation of all of these facilities amount to about \$8,000,000 annually, out of which some 4 to 5 million dollars will be available each year for port expansion and future construction. The

through which we now trade. Its present stage of development represents a visible and tremendous tribute to the early pioneers who first conceived the concept of a world port, a vindication of the confidence of the citizens of Los Angeles who voted its first bond issue, a symbol of accomplishment to the past employees of the Port who brought this concept into fruition.

Economic studies by qualified economists estimate that the production capabilities of the American economy will be nearly doubled the current level by 1975. The growing population of the United States, particularly the southwest area served by the Port of Los Angeles, will become increasingly dependent upon essential supplies for more and more of the much needed raw



Fig. 6. Interior view of completed transit shed.

harbor now covers about 7025 acres and there are 28 miles of waterfront. The majority of the land area of this property was the result of dredge and fill operations. Other property was acquired by purchase and condemnation actions.

The main channel connecting the inner and outer harbor and dredged to 35 foot depth is travelled yearly by more than five thousand vessels, moving through the port some 26½ million cargo tons.

There are more than 12 miles of marginal wharves along the waterfront of the Port of Los Angeles and a little more than four miles of transit sheds paralleling these wharves. The sheds total twenty-seven in number and include total wharf, platform and ramp area of about 140 acres.

Future Development

The Harbor represents the trading threshold through which is received the things needed and through which are shipped the products of labor to the oceanic world

materials. These studies of population growth and increase of business activity in the southwest area of the United States, and more particularly the Southern California area served by the Port of Los Angeles, indicate a need for addition of at least one complete terminal, consisting of about a 1000 feet of wharf, 200,000 square feet of transit shed, with 7 acres of paved storage to be constructed every two to three years.

The natural advantages of the Port of Los Angeles are geographical location, land transportation, and the all important backland, or paved uncovered area to accommodate outside cargo storage as well as trucking and railroad access, for the development of terminals which can handle large volumes of cargo efficiently. These natural advantages, and the demand of shipping companies for additional terminal facilities, place a tremendous burden on the Port of Los Angeles to continue to provide large sums of money for financing the necessary port development.

The Port of Los Angeles—continued

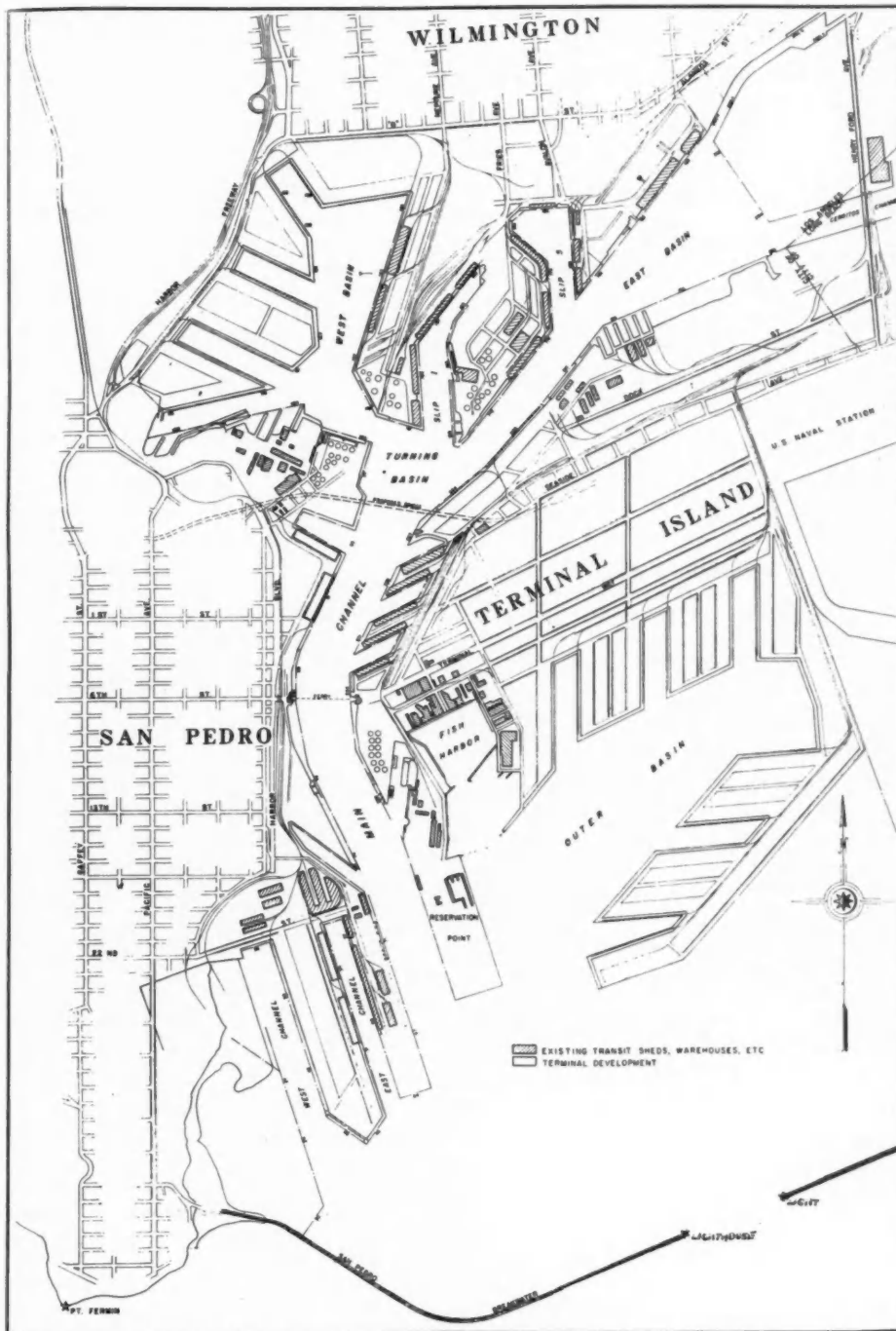


Fig. 7. Los Angeles Harbour. Scheme of Future Development.

Since this harbor came into existence with the construction of the first section of the breakwater at the turn of the century, the pattern for the port development established by the Corps of Engineers of the U.S. Government has followed. Planning for the future must recognize what has already been accomplished and be co-ordinated to it. With this premise in mind, the Harbor Commission has authorized a \$35,000,000 Construction Program to be completed by the

end of 1965.

Presently under construction as a part of this program is a cargo-passenger terminal for operation by the American President Lines, consisting of a 48-acre unit with a marginal wharf of almost a third of a mile and 400,000 square feet of covered shed area. Also about 21 acres of parking and open cargo storage space are available to this terminal. This facility will provide automobile and passenger ramps to the second

floor passenger area which will efficiently accommodate 1200 to 1500 passengers and their baggage in a matter of two or three hours. The total facilities are expected to cost about \$16,000,000.

Also planned for completion before 1965 is 3000 feet of wharf and 360,000 square feet of shed area, with about 20 acres of backland development at Berths 51-55. A second terminal of equal size will be constructed at Berths 136-139, and a third terminal at Berths 218-224. Also included in the Construction Program is a new Administration Building to accommodate Port personnel.

Another facility to be constructed is 3000 lineal feet of wharf to accommodate containerized or lift-on/lift-off cargo, as well as an additional 1200 feet of wharf to provide for construction of a multiple product bulk-loading facility for handling heavy bulk cargoes such as iron ore and the like.

The completion of this Construction Program will provide 14 to 16 new berths, of which 3 berths will be replacements, and approximately 970,000 square feet of transit sheds and about 50 acres of backland development. This construction is planned as an integral part of the logical and orderly development of the Port of Los Angeles that will accomplish the most efficient and modern port operation in the foreseeable future.

After completion of the above construction, the next area of development is the Outer Basin and the west side of the West Basin. The construction of new terminals in these two areas, having adequate backland, will virtually double the present cargo handling capacity of the port. This planned development is clearly shown in (Fig. 7). It is expected that the complete development of this area will not be required for at least 20 years; however, growth rates in Southern California have increased at unprecedented rates in the past, and the Harbor Department future planning is capable of meeting these unusual demands.

With the tremendous growth of population and industry in the southwestern area of the United States, the Port of Los Angeles must continue to expand and enlarge to meet the demand for new harbor facilities. A port being a very complicated affair, and the requirements of the operations which it must satisfy in accordance with new developments of ships, kinds of cargo to be handled, the means of land transportation and the desires of shipping companies, makes for a complex engineering problem. The utilization of outside specialists is necessary many times, but the Engineering Department of the Port is always responsible for the coordination and accomplishment of the necessary construction work. The future development and construction of this port will continue to be a challenge to the Engineering personnel of this Department.

A Port in relation to the National Economy

With Particular Reference to the Working of a Trust Authority

by A. S. MOUNTFIELD

(General Manager, Mersey Docks and Harbour Board)

In an address given on April 7th last to the Merseyside and District section of the Institute of Transport, Mr. A. S. Mountfield drew attention to the importance of efficiently operated ports to the national economy in peace and in war. Extensive abstracts from his paper, which also dealt with the problems of management and the differences which exist between ports, are printed below.

The age long problem of port management has always been how to marry the general need to the particular and weld both into the national need. When it is observed that the imports into the United Kingdom last year were 112 million tons with a value of £4,008,000,000 whilst exports were of the sale value of £3,456,000,000 and some 25 million tons, this emphasises the country's dependence as a nation on overseas trade in normal times.

It is very difficult to find a common parallel between ports. Primarily they differ because of the geography of their harbour and the tidal and other conditions involved but also because of the differences in the geography of their hinterland. Certain differences at once become apparent even to those not versed in port work, for instance the outstanding difference between the port dealing in specific bulk commodities and the great general cargo port trading to all parts of the world. These differences are reflected in the varieties of constitution of the controlling authority. There are in Great Britain five main forms of port authority. These are :—

- (1) The statutory Trust such as Liverpool and London, which is largely representative of the users of the port, with some admixture of Government representation.
- (2) The British Transport Commission ports which have, in large measure, taken over those ports built by the railways in past years as part of their undertaking.
- (3) The municipal, of which the outstanding example is Bristol, controlled by the City of Bristol as part of the civic duty.
- (4) The statutory company—the prime example here being The Manchester Ship Canal which operates under Acts of Parliament but is constituted as a company with a share capital.
- (5) The private industrial port built by some great industry to serve its own purposes, of which an example is Bromborough Dock built by Lever's.

It would perhaps be right to think in the first place of the constitution of the Port of Liverpool and how it emerged. The Port of Liverpool was developed originally by the Corporation of Liverpool as far back as 1709. Powers were taken to construct a dock which increasing trade and larger ships was rendering essential in view of the tidal conditions of the Mersey. From that small beginning has spread the great line of dock works on both sides of the River which one may reasonably say is one of the wonders of the modern marine world. Just over 100 years ago pressure from the interests which had become involved in the Port in the shape of up-country traders and manufacturers and the growing influence of the railways led to a separation of the Port from the Municipality and the setting up of a Trust, the Mersey Docks and Harbour Board. This Trust is composed of 28 Members, 24 of whom are elected by those using the Port and 4 of whom are appointed by the Minister of Transport.

The Board operates through a series of Committees dealing with the different functions of port operation. These Committees

lay down the principles of policy and by a series of reports and explanations keep their hand firmly on the varied aspects of the work of the Port. All the Board's organisation operates through carefully balanced structure stemming from the General Manager as Chief Executive to the Heads of Departments.

To deal with the question of the financing of the Port, its revenue, some £10,000,000 per annum, is obtained to the extent of 8 millions or more from rates and dues levied on vessels and goods. The balance is obtainable from charges for specific purposes, graving docks, warehousing, rail haulage, etc. In disposing of this revenue the Board must pay the interest on the monies which they have borrowed to construct the Estate. These monies are all borrowed with the consent of Parliament and, today, in amounts sanctioned by Parliament. They must maintain their Estate, including the payment of their large staff, some 9,000, engaged in its maintenance and operation (this does not include dock labour) and make suitable appropriations to reserve funds. All they do is governed in one form or other by the sanction of Parliament which has given by-law making powers to the Board to deal with the lesser objects requiring legal control.

It should be stressed that in this country there is no subsidy to the ports. In this way practice differs very much from that adopted in so many countries abroad where either the State or the Municipality connected with the Port are in large measure responsible for its financing. The practice adopted here maintains the good principle of trade standing on its own in as much as the operation, maintenance and financing of the ports is provided for by the charges which the Authority is allowed to levy. Obviously the provision of efficient arrangements in a port is of benefit to the economy of the country in a very direct manner in that it enables a more economic use of ships to be made and for costs on cargo to be eased either in the short term or the long. To obtain the maximum effect in these directions necessitates the constant watchfulness of the Authority and its officers and, in particular, a very close and harmonious relationship with the varied interests using the Port. Only by this means can a maximum total effort be produced.

One of the vital differences between Liverpool and certain other ports is that the work of discharging and loading vessels and of the numerous operations necessitated on the quays in the removal of inward cargo are not carried out by the Port Authority but by those whom the Authority licences. These individuals or Companies are known as Master Porters, Master Stevedores or Master Lumpers according to the varying functions they perform. The duties of Master Porters, i.e. handling of inward cargo on the quay, are laid down by Statute and by Bye-laws which stem, as has already been explained, from Acts of Parliament, and define such duties in clear and lucid manner. The rates which they are empowered to charge are subject to the approval of the Minister of Transport and are arrived at by agreement between the varying interests concerned. Labour is, of course, obtained from the National Dock Labour Board on the terms of the Dock Labour Scheme. There has been much criticism and various enquiries have been held into the working of the scheme. The essential thing seems to be to use every possible means to work in the spirit of co-operation with labour as with other parts of the Port's life so that a maximum effort may be obtained.

Dealing with the operational functions of a Port Authority, and using as example the Mersey Board (in many ways but not all

A Port in relation to the National Economy—continued

typical)—these start in the case of the Mersey with the provision of the Pilot Service which operates under the Pilotage Act of the country with orders made thereunder. The next function is that of Conservancy, i.e. the dredging and maintenance of the channels, including their training; the surveying, which is the key to all this, and their lighting and buoying; an added responsibility being the clearance of obstruction, by way of wreck or otherwise, with all that this entails in the complications of liability and responsibility. The acquirement of land for dock construction, construction of the vast works which a 30 ft. rise and fall of tide necessitates, and their maintenance. The provision of facilities for warehousing, particularly in bonded cargoes; the provision of proper facilities for certain commodities of this nature is a help in the securing of traffic to the Port which might otherwise be spread in directions less advantageous to the overall economy of the country. The supervision of the vast range of dock operations carried out under licence; the administration of the Master Porters' Bye-laws and Regulations with all that those entail.

The allocation of berths in the Port in relation to length, draught and the nature of the cargo. Many of the regular shipping firms using the Port have their own appropriations. These are not leaseholds but are berths which, on payment of a consideration, the shipowner can regard as his home. This is of tremendous value, particularly in the outward trade, and the settlement of such appropriations is a matter requiring the very balanced judgment and consideration of the Board.

It has been the Mersey Board's practice over the generations to do a vast amount of their engineering work either with dock construction or of restoration or repair by direct labour rather than by contract. Endless arguments can take place over this but the establishment which has been created and which is used according to the wise judgment of the Board's officers in the several functions of such work is considered to be appropriate to the circumstances. One must never forget in dealing with a great tidal port such as Liverpool that the constant enemy is nature which, by giving a tidal rise and fall of 30 ft. coupled with an up-river reservoir providing a current of unusual velocity and strength, presents problems that are no ordinary ones for the Port Manager to cope with. It must be borne in mind that from the Mersey and docks the Board dredge some 20 million tons of sand and silt a year and this great volume of material is deposited in places at sea.

It will be seen that the task of a Port Authority is an unusually heavy one. Far from it being merely a toll collecting agency or the provider of quays in a placid waterway, it has to provide the strongest works of engineering in order to preserve the shipping and cargo entrusted to it.

In all considerations of future work and financing, a long vision is necessary. To plan and execute a dock construction scheme means in general that if it is of any size one must look ahead something in the nature of 10 years before it is constructed. Such schemes do not necessarily pay for themselves at once; they must, of necessity, present an additional burden to trade for a time. The provision of a new dock may, it is true, be so calculated as to serve an increasing volume of traffic of some order and the normal commercial calculations can, therefore, be made, but there are endless works of modernisation of which one can only say that if they were not done traffic might well be diverted. Their being done means that existing traffic is held but no more and, therefore, in some measure or form, an extra charge is thrown upon the general traffic which may be very ready, of course, to bear such a charge for an added facility. This, after all, is a problem common to all public industry, particularly to transport, a factor which is not always appreciated by those not versed in public economy. But the problem is no new one; economic history points to a steady trend in the development of the ports of the country. There is the displacement of the tiny port which could handle its little local craft in favour of the large utility serving a highly concentrated

industrial centre.

This trend led naturally away from control by private interest or municipality towards the evolution of the Trust form of control, as evidenced by first Mersey, Tyne and other Ports and finally London.

What is the financial basis of a great Trust port?

First of all—these Trusts do not work for profit. Any surplus of income over expenditure is devoted either to the reduction of debt or the improvement and modernisation of their estates. Secondly, funds can only be raised from the public by borrowing with the consent of Parliament. Thus they differ from those public utilities which are run as profit making industrial concerns and from local authorities. Those utilities coming within the industrial category can build up their reserves by adjustment of dividends and can modernise by raising more share capital. Local authorities are able more freely to raise their rates in order to balance their budget and are not faced with the competition element (other than the fact that new industry may be attracted elsewhere) to anything like the same extent as a Port. Thirdly, Ports are involved in a measure of over-riding control from the Minister on appeal or directly in various forms. This is linked with statutory maxima of rates and dues prescribed by Act of Parliament. This requirement when invoked necessitates the Minister satisfying himself that no interest affected has a legitimate grievance.

The capital works of a Port Authority must rank of necessity amongst the most permanent works of man. The very nature of the forces of tide and wind with which they have to contend requires this. Consequently, works have to be planned well in advance of the time they are expected to be required. It is no use planning for the accommodation of ships when they are already on the seas. Not only does this apply to the dock works themselves but to the land on which they are to be built. This land may have to be acquired generations before it is needed and during the intervening period the Port Authority must make the best use they can of it—even if it is only the grazing of cattle. In buying and temporarily sterilising such land the Authority must have regard not only to the dock works themselves but to the land which may be required to lease to those whom it may be hoped will establish industries alongside the water space and thus ensure the continuity of traffic. In passing it may be remarked that an Authority does not lightly dispose of its land for purposes other than those designed to increase or conserve the traffic of the Port.

The capital necessary to finance new work is raised from the public under statutory authority. In some cases of new construction this is a clear issue but there are other and perhaps more numerous cases where new work takes the place of an existing work and the problems of betterment and obsolescence arise. But the real and major problem of Port Authorities is the servicing of their capital—whether they can afford a scheme costing £y which will throw an annual burden of £x on their revenue.

It is of infinite importance that obligations should not be incurred which would have the effect of burdening the trade of the Port to an unfair extent, i.e. mortgaging the present for the sake of the future.

The Port Authority having ascertained the service charges on a proposed expenditure, having weighed any savings which may conceivably be estimated for as a result of replacement of obsolete property or otherwise the additional revenue, if any, which may be expected to be derived from the operation must see that it is carefully balanced. It may well be that the whole account will show a totally one sided debit balance as in many a scheme of modernisation (without the spirit behind which the Port will surely die) there is theoretically no additional traffic to be gained by the substitution of new works for old. On the other hand, if the work is not undertaken (a) traffic previously held may be diverted to more up to date Ports and (b) any "additional" traffic on the seas

A Port in relation to the National Economy—continued

will definitely be lost.

It is, therefore, apparent that no narrow profit and loss view is of avail when a public utility undertaking considers major capital works. The plain fact is that the public pays, as in the case of all public utility undertaking expenditure—the only point is to what extent the public gains a commensurate advantage. Doubtless the shipowner in arriving at his appreciation of the economy of his fleet has regard to the high incidence of running costs in the sum of his expenditure, rendering it more than ever essential that his ships should not be kept unnecessarily standing by waiting for the opportunity to dock. But no strict profit and loss account can be kept of such transactions.

The incidence of the Port Charge must be the next point for inquiry. Consideration falls under two heads:—

- (a) The charge on the ship—which normally cannot be passed back on to the consignor or consignee. Charges on ships are based on a rate per net registered ton, i.e. the freight earning tonnage, and lend themselves to differential of various kinds.
- (b) The charge on the consignor/consignee for dues on cargo, handling, etc., and road/rail charges.

Now as to Dues on goods. These are very old in origin owing their first existence, before the days when the increasing size of vessels needed extensive dock works, to the toll levied by municipalities on the goods of "foreigners". As works were provided the basis of the Due or Rate tended to change from that of "toll" to that of service charge. The result of the years in effect has been that dues, tolls or charges for the use of a Port must be devoted to the use of that Port for no other purpose. The Mersey Docks & Harbour Act 1857 states that "no moneys receivable by the Board shall be applied to any purpose unless the same conduces to the safety or convenience of ships frequenting the Port of Liverpool or facilitates the shipping or unshipping of goods; or is concerned in discharging the debt contracted for the above purposes". Furthermore, that the right of levying Dues "be applied to the benefit of the Port of Liverpool and of the shipping and trade of the said Port".

Broadly speaking the revenue of a Port is derived equally from ship and cargo but naturally in times of great buoyancy of trade and still more in times of War when much less tonnage carries more cargo this proportion is upset. The relationship forms a useful barometer to read in conjunction with freight levels.

The particular problem of a Port Authority in budgeting for its revenue is this. It is neither entirely a non-competitive public utility undertaking nor a commercial concern. If you disagree with the charges made for certain utility services you seek to transform your factory to some other mechanism or locality—and may find you have no alternative. But the shipowner faced with what he considers to be excessive charges may have an alternative. True if he owns a liner fleet operating a regular service the proximity of industry and other factors may tend to induce him to retain a service to or from a Port, but if he is a tramp operator he may bend all his ingenuity to an endeavour to avoid the Port in question. More directly in the opinion of some is the effect of high charging policy on cargo.

Increased efficiency may develop largely as a result of an ideal of service which will permeate all angles of the authority's staff and their approach to the problems of the Port. But it may also develop the need for better facilities of one kind or another and this leads automatically to the question of charges. As we have seen there is only a revenue derived from x shillings per ton to play with and it is essential that that revenue should be so applied as to obtain maximum efficiency for the lowest possible monetary value to represent the symbol x . In a normal industrial undertaking it is perhaps easier by the study of an efficient costing system to put one's finger on the weak link and cut out the uneconomic unit. It is not so easy in the varied undertaking of a Port with its

complexities of problems, operations and duties to a public. To cut out something that is not by itself economic may prove to be unfair to some section of the Port's users. It is easy perhaps to show that the revenue derived from a certain group of docks is not, owing to the play of natural forces or some other reason, commensurate with the expenditure involved but many and varied interests may have been built up on those docks. Nevertheless some system of indicating revenue and expenditure on a particular asset is essential if a proper economic assessment of a Port is to be obtained, firstly from the point of view of the dock owner but secondly from the point of the Authority as the governors of that complex of interests called a Port.

This problem of revenue is, of course, inextricably linked to the revenue producing hinterland of a Port. This cannot be exactly defined. For instance, Liverpool may be said to have a clearly defined sphere of influence over the North Midlands and a great part of the North of England (a sphere shared by Manchester, Hull and the N.E. coast) but a considerable area of the South Midlands is less clearly defined between Liverpool and Manchester, Bristol and S. Wales Ports and, of course, London.

All estimates based on population and other data, statistical and economic, tend to be fallacious. It is true to say that traffic finds its true economic channel, in finding which channel Port charges as such may not play so large a part as efficiency.

In assessing efficiency the Port Authority is in the hands to an extent of other bodies or groups of bodies, for example those responsible for rail and road. The former in providing or improving on what their more speculative predecessors have provided in the shape of rail access. The second in the difficult problem of giving clear approach roads. The loss of time through inferior terminal arrangements or a system of roads which does not provide vehicles with a rapid unloading medium both add considerably to the economic costs involved. The whole relationship of Port and Municipality is a somewhat confused one—Trust Ports having often developed out of the municipal ownership of the simple Port facilities of an earlier day. The point at which Port Authority responsibility for the communication between say two sides of a harbour, on the efficiency of which transport and success of the Port so largely depends, can be a vexed question, dependent on geography and local history. The certain fact which emerges out of the welter of legality, of practice and sharing of financial burdens is that Port and Municipalities are partners in a common enterprise.

The efficiency of the Port is likewise linked with many ancillaries such as mobile cranes, towage, cartage, etc. Broadly all these are matters governed by the general term—practice of the Port, and it is sufficient to be aware of the incidence of their cost on the quantum of Port charge. The true economic level will ultimately be found, whether in the competitive stress of private enterprise or the strongly capitalised security of public ownership. These remarks apply to the much larger question of cargo handling on the quay (far too important to be of the nature of ancillary). As already mentioned, the complicated operations on the quay, sampling, weighing, sorting, etc., are at some Ports performed by a Master Porter—at some Ports a person or firm (often the shipowner) licensed by the Authority, at other Ports the Authority itself.

The Royal Commission on Transport in 1932 made use of these words:—

"Without shipping the Port is useless—without the Port shipping is helpless. Their fortunes are inextricably bound together.

It might be added, so are the fortunes of shipping and the Ports with this Island Community of Great Britain. In other words, the varied and complex interests which make up that republic which in fact a great Port is have a common bond between each other and the body politic they make up has a similar link to the greater community of which it is a part.

Construction of a Dry Dock at Havana, Cuba

By CHARLES M. J. W. KOHLER, P.Eng.
(Resident Engineer for Frederic R. Harris, Inc.)

The construction of a new dry dock at Havana has been quite unusual, because conditions at the site required a design and method of construction by which the dock walls had to be built in 40-ft. of water. The dock consists of gravity walls and a relieved floor. All concrete under water has been made by injecting grout into previously placed stone.

The procedure of building these walls was as follows (see drawing): to support the pre-fabricated wall forms, which afterwards formed the constructive part of the dock walls, steel sheetpile walls were first driven, which were at their outside supported in a lateral direction by guide frames, driven ahead of the sheetpile walls.

After this was done, the bottom between the sheetpile walls was trimmed to the required depth and a key dredged, which gives support to horizontal forces, acting against the outside of walls, when the dock is dewatered.

By means of air-lift pumps, the bottom was then cleaned of all silt deposits which might otherwise contaminate the stone when this was dumped into the water.

The next step was the placing of the pre-fabricated steel wall forms, which consist of angle-iron frames to which the reinforced bars and shutterings had been attached. These wall forms were lowered into the water to their correct level by a floating crane, and hung from the sheetpiling by welding them at two points to horizontal pieces of channel-iron, which were attached to the sheetpiling.

The wall forms for the outside walls were lined with corrugated-iron sheets, both inside and outside, whereas the inside wall forms had corrugated sheets at the inside and plywood at the outside (inside of the dock), to produce a smooth concrete surface.

The corrugated steel linings at the inside of the wall forms were placed in order to

separate the injected concrete inside both wall forms from the stone fill between the wall forms, which was only placed for stability of the walls.

At the bottom, to elevation -29.00 the inside and outside r.c. walls are interconnected by means of a reinforced concrete slab, and the top of these walls afterwards tied together by reinforced concrete tie beams, spaced about 26-ft. between centres.

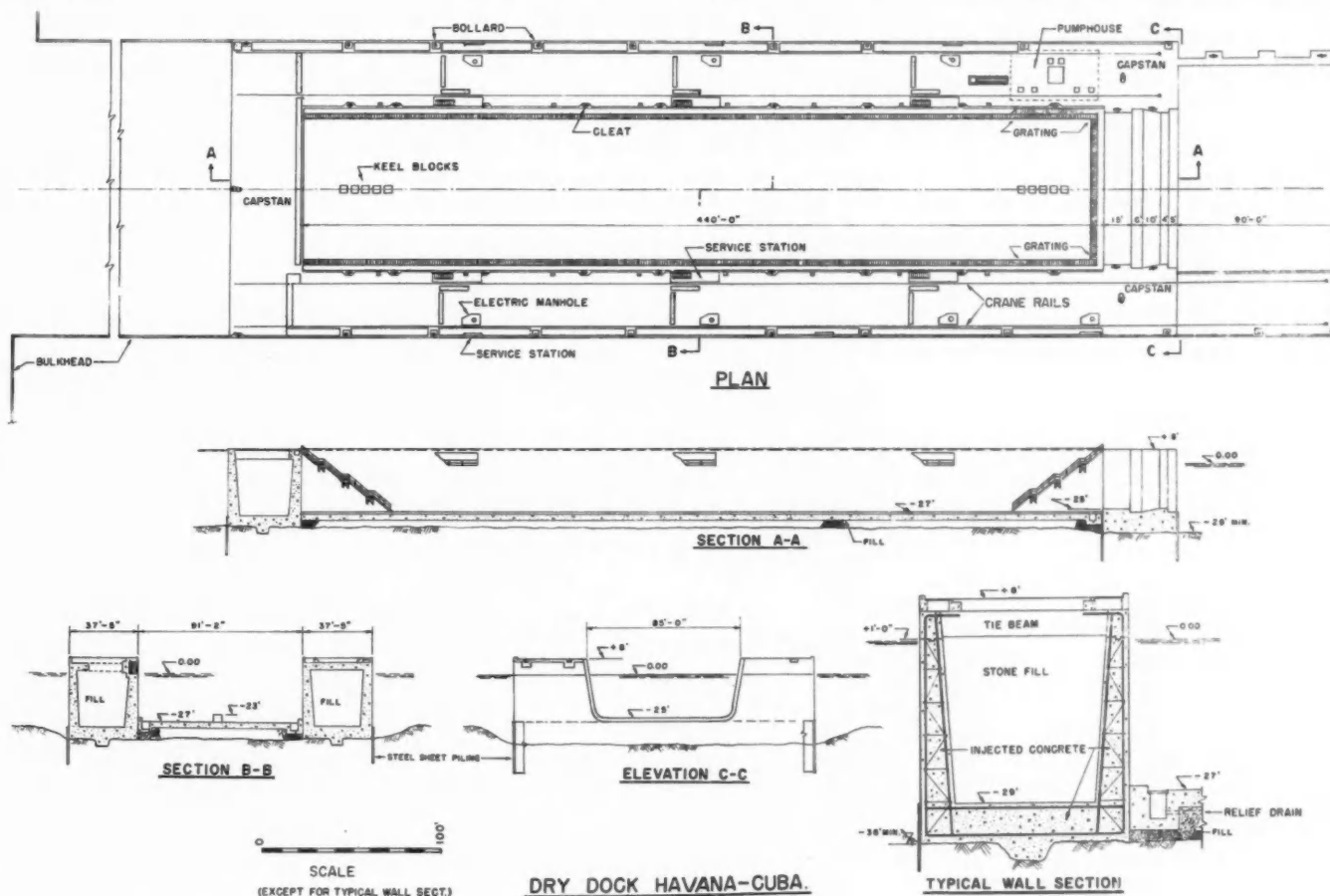
Stone was first dumped to elevation -35.00 and the bottom horizontal reinforcing steel mat placed. The level of the stone was then brought up to elevation -29.50 and the top horizontal reinforcing steel mat placed.

One inch dia. grout pipes and two inch dia. sounding wells (to control the level of the injected grout) were then placed. These were held at the top in a vertical position by attaching them to I beams, placed across the walls.

Dumping of stone was then continued to the top of the injected concrete level to elevation $+1.00$.

To prevent the wall forms from spreading at the top, due to the pressure of the stone fill, steel tie rods were placed at elevation $+1.50$ across the wall forms, between the inner and outer rows of sheetpiling.

To support the plywood and corrugated steel sidings at the outsides of both walls,



Dry Dock at Havana—continued



View of dry dock and approach pier under construction.

the space between the ondulations of the sheetpiling and these sidings was filled with quarry dust.

The joints between the wall forms, were carefully sealed by means of curved sheets of corrugated steel sheeting, which rested against small angle-irons, welded to the corrugated sidings of the adjacent wall forms, near these joints.

To consolidate the stone fill, ordinary pneumatic concrete vibrators were used under water, each time after dumping a 2-ft. layer of stone.

It was imperative that all stone was very thoroughly washed before placing.

Although at the beginning it was feared that marine growth would cover the steel, before the grout was injected, in this way reducing the bond of the concrete to the steel, it was found that in still water, the building-up of a layer of marine growth is negligible and is easily scraped off by the dumping and vibrating of the stone.

Normally the time between the placing of the wall forms and the injection of the grout, was not more than 8 to 10 weeks.

The dock wall are divided into 7 sections, one head wall and three sections along each of the longitudinal walls. By doing this, the time lapse between placing the wall forms and injecting grout was reduced to about 10 weeks. The grout was injected in one continuous operation in each section.

For the floor at the entrance of the dock and of the Pumphouse, the grout was injected to pre-determined levels below finished floor level. Dowels were provided to bind the injected concrete to the floor topping. After this, the braced cofferdams were dewatered and the rest of the constructions for the floors and walls of the

entrance section and pumphouse, carried out in the dry.

When the concreting of all the walls and of the pumphouse was completed, the gate was placed in the outer groove at the entrance and the dock dewatered for the construction of the dock floor.

The sheetpiling along the outside of the dock walls, was burned off under water at elevation -29.00 to act as a seal, and the sheetpiling at the inside removed. In some places where the extraction of the inside sheetpiling was very difficult, this sheetpiling was burned off under water below the level of the finished dock floor.

Three service stations have been provided along each dock wall and three along each outside wall. Salt water, fresh water, compressed air and electricity are supplied at these stations.

The dock is 440-ft. long (working length when the gate is placed in the inner groove), 91 feet wide between the walls and has a depth of water over the keel blocks of 23-ft. at low tide. Normal difference between low and high tide is about 18-in. The top of the walls is at elevation $+8.00$, low tide level being 0.00.

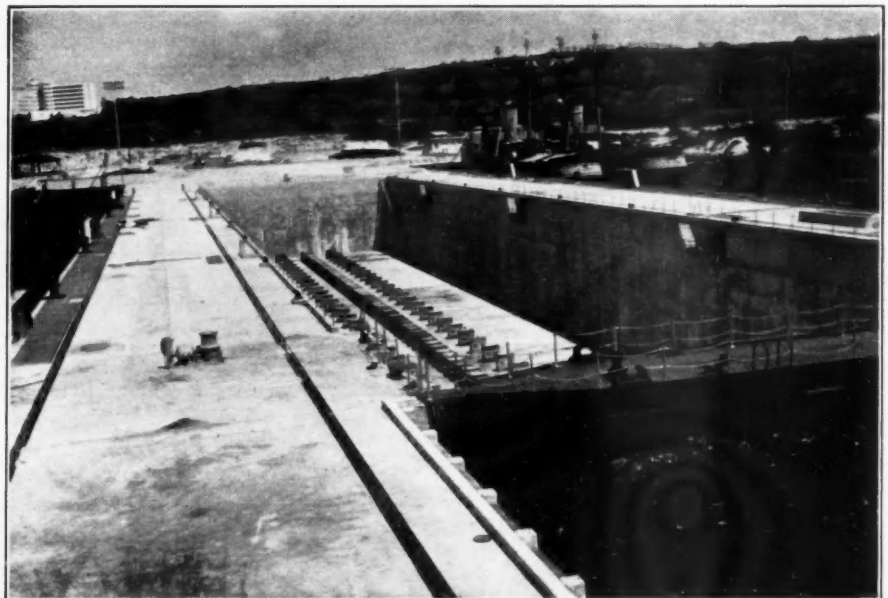
Next to the entrance a 90-ft. long Approach Pier was constructed on the west side, which can be used for outfitting ships, and a Gate Mooring Pier was constructed at the east side, to which the gate can be moored when a ship enters or leaves the dock.

A gantry crane, capable of lifting 45-tons at 30-ft. radius or 10 tons at 105-ft. radius, runs over the west wall of the dock. Crane rails for this crane have been provided on both dock walls. These tracks are interconnected by a switch at the north side of the dock.

The dock can be lengthened in the future by extending the side walls, alongside the present two bulkheads, and constructing a new head wall and floor section. After this has been completed, the present head wall can be removed, by placing the gate and dewatering the dock.

At the north end of the dock, beyond the area for future extension, will be built the workshops, offices and stores which are required for the operation of a modern dry-dock. The Compressor House and Electrical Substation have already been built.

(Continued at the foot of following page)



View of completed dry dock.

Mechanical Handling Plant for Port of Emden

New Coal and Coke Loading Installation

by JOHN GRINDROD, B.A.(Com.)

A new coal and coke installation which combines careful handling with efficient utilisation of the ship's holds capacities, was recently brought into use at the port of Emden, Western Germany. Constructed by Demag A.G., of Duisburg, the new plant is being used for transferring coal and particularly coarse blast-furnace coke from railway wagons into sea-going vessels. It has been designed to incorporate an existing wagon tippler gantry and is of the mobile type, capable of quickly serving the various holds of a ship in turn without the necessity of warping the vessel to different positions. In order to prevent fracturing of the material the device permits its gentle sliding from one conveyor to another, eliminating all falling, throwing or grabbing operations.

Although careful loading of a ship's holds had previously been achieved by means of bottom-dump buckets filled at the wagon tippler gantry, this system failed to distribute the material efficiently under the main deck and the 'tween deck and trimming had to be resorted to. Instead of filling the bottom-dump as hitherto, the wagon tippler gantry now discharges into a trough-type feeder, which, in turn serves a belt conveyor running longitudinally with the quay. From there, the material is transferred to a belt conveyor bridge operating at right angles to the quay and fitted with a lowering device and a swivelling and extendable trimming belt conveyor.

The stationary tippler gantry which is

capable of tipping 15 end-discharge wagons an hour, spans five railway tracks, four of which are used for loaded wagons and one for empties. It hauls each loaded wagon onto a platform suspended from lifting ropes by means of which hoisting and lowering to required levels, as well as tipping, are accomplished. After being raised, the wagon on its platform is transported sideways by means of the overhead trolley of the gantry, lowered and then tipped endwise, and a trestle fitted with guides ensures that the platform is correctly placed at the fixed tipping point. The platform is equipped with a discharge hopper which terminates in an electrically operated round sliding gate.

This equipment can deal with the wagons whichever way they happen to be facing on the tracks. For those positioned with their discharge ends the wrong way round for tipping, the platform is turned 180 degrees before being put down on the track, and when hoisted, is swung round into its correct discharge position by slewing the overhead trolley. With a lifting capacity of 60 tons, span of 112-ft., headroom of 56-ft., hoisting speed of 59-ft./min. and trolley travel of 164-ft./min. and trolley slewing of 2 r.p.m., the tippler gantry has a maximum handling capacity of 790 cu. yds. an hour, corresponding to about 270 tons of coke or 480 tons of coal, and it is to this performance that the entire new installation is geared.

Since wagon loads are discharged intermittently and over a short space of time while the longitudinal conveyor belt delivering to the transverse loading bridge requires to be fed at a slower uniform rate, an intermediate equalising device has had to be installed between the tippler hopper and the belt conveyor. This takes the form of a mobile trough feeder which sheds its load onto the belt conveyor during the interval of time between one wagon being removed and another being placed in position for tipping. The trough feeder, which has an overall length of 64-ft. and a maximum capacity of 59 cu. yds., after receiving its load, moves at a relatively high speed from a right- to left-hand position under the sliding gate of the tippler platform discharge hopper. During this operation it takes about 20 seconds for the feeder to travel a distance of 46-ft. to reach its left-hand end position.

The bottom of the feeder is formed by a short 55-in. wide conveyor belt with stationary terminal pulleys at 52-ft. 6-in. centres. This is attached to one end of the feeder and is set in motion when the latter is moved along. When the feeder is at the extreme right-hand position its bottom is open while when it is in the extreme left-hand position it is closed.

Having received a wagon load of material, the feeder trough moves slowly back to its original position delivering the material by way of a chute onto the main longitudinal conveyor line which runs beneath it. Its speed can be adjusted to suit any size of material within a range of 0 to 3-ft. 6-in. per sec.

The longitudinal belt conveyor has a speed of 5-ft. 4-in. per sec., and is 600-ft. long between terminal pulley centres and 47-in. in width. Its troughed upper strand is supported on three-pulley idlers, correct alignment of which is ensured by adjustable idlers placed at intervals and the tension is provided by a gravity-type take-up. It ascends to an overhead supporting framework and runs in an elevated horizontal position over a length of 355-ft., which distance corresponds to the maximum distance between the hatches of a 10,000-ton vessel. Delivery to the transverse belt conveyor bridge can be effected at any point within this distance by means of a throw-off carriage which is moved along with the bridge and which feeds the material onto the fixed belt conveyor within the bridge.

The belt conveyor bridge, with a span of 175-ft. and a headroom of 38-ft. 5-in. from rail level to the underside of the bridge girder, has a fixed and a mobile rubber belt conveyor 112-ft. and 157-ft. long respectively both of which operate at 6-ft. 3-in. per sec. The former extends from the feed point at the throw-off carriage to about the centre of the bridge where it delivers the material onto the latter which is made up of four movable sections. The quayside end

Dry Dock at Havana

(Concluded from previous page)

A siding from the existing railway, which runs about a quarter of a mile to the north, will be constructed to give access to the docksite by rail.

In the Pumphouse are 4 main dewatering pumps (in two pairs), 2 fire pumps, 2 sump pumps and a sewer ejector, servicing a ship in dock by connecting the discharge pipes of the ship to sewer pipes embedded in the dock floor.

The main dewatering pumps can empty the dock in 3½ hours, without a ship being in the dock.

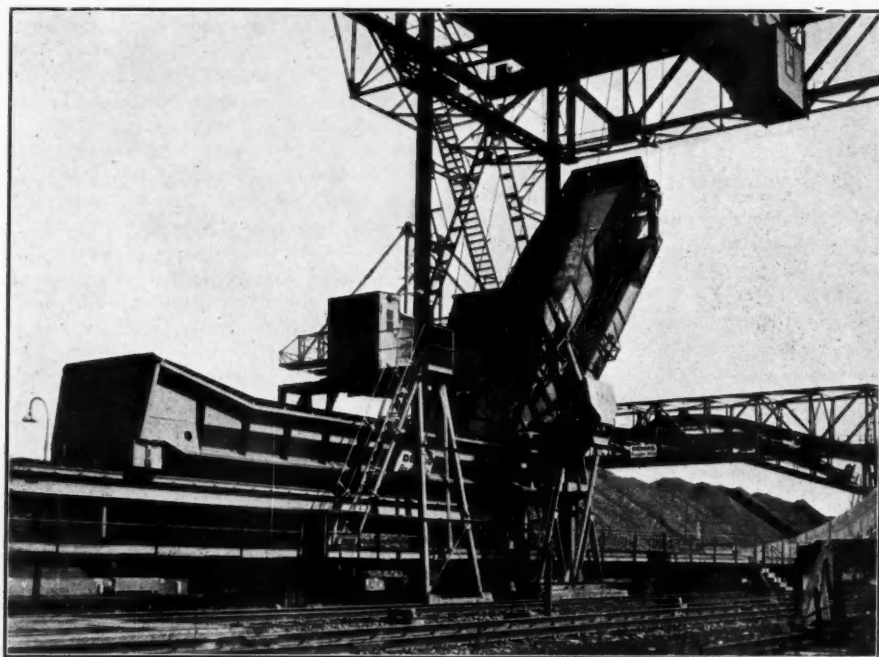
The dock area is floodlit by four 60-ft. high poles with clusters of flood lights, and connections along the dock walls can serve portable flood lights.

To assist a ship entering the dock, three capstans have been provided on the dock

walls, two near the entrance and one on the head wall.

The design of the wall forms and methods of construction, are patented by the Consultants, Messrs. Frederic R. Harris, Inc., Consulting Engineers of New York City and the Hague, Holland.

Until the revolution, the construction was carried out by: Constructora Mendoza S.A. of Havana, Cuba. After this, the supervision was in the hands of the Dept. of Public Works and the Cuban Navy. The grout injection was sublet to Messrs. Lee Turzillo Co. of Cleveland, Ohio, under the direction of Mr. John D. Anderson. The electrical and mechanical work was installed by Constructora Triplex, S.A. under the supervision of its President, Mr. Rodolfo Verdes of Havana, Cuba.



Now at its extreme left-hand position the trough feeder has received the contents of the tipped wagon and will move slowly to the right, distributing its cargo on to the longitudinal feet beneath as it moves along.

of the mobile conveyor is attached to the lowering device by means of a swivelling connection and when the lowering device is retracted the mobile conveyor can slide under the fixed conveyor. The bridge apron is capable of being raised or lowered in about 3 min., while the speed of travel of the bridge is 188-ft. per min. and of its trolley 66-ft. per min. On the quayside the bridge has an outreach of 69-ft. and on the land side 44-ft. 4-in.

The lowering device is of the elevator type, carrying the material vertically down-

wards at a speed of 2-ft. per sec. in compartments each having a capacity of 0.4 cu. yd. The compartments are formed in the shaft by a 34-ft. long, 3-ft. 6-in. wide rubber belt provided with integral collapsible plates. With a minimum outreach from the centre of the bridge of 26-ft. 3-in. and a maximum outreach of 52-ft. 6-in., the device has an effective lifting height of 46-ft. and a lifting speed of 28-ft. per min. It is suspended by ropes from an overhead trolley and is raised and lowered by the hoist machinery. Transverse displacement

within the ship's load is effected by means of the trolley while longitudinal displacement is effected by travelling the conveyor bridge. Since ship loading operations have to be carried out in certain sequence to avoid hull strain, the lowering device has to be moved frequently from hatch to hatch and appropriate operating speeds have been adopted for retracting it so as to reduce to a minimum the transfer time involved.

In order to spread the material evenly throughout the hold of a ship, a horizontal trimming belt conveyor is used at the bottom of the lowering device. This is suspended from a ball race and can be swivelled through 360 degrees at a rate of 1.3 r.p.m. It can be operated with trimming conveyors of different length according to the size of hatch being worked and these can be extended to reach the corners of the holds. The belt has a width of 39½-in. and its speed can be smoothly adjusted between 6-ft. 6-in. and 19-ft. 7-in. per sec.

Four points of control are incorporated in this handling system. All operations up to the placing of the railway wagons in the tipping position are controlled from a cabin on the wagon tippler gantry, while wagon tipping, filling the trough feeder and delivering the material onto the longitudinal belt conveyor are carried out from a cabin over the feeder. A control point at the trolley of the conveyor bridge provides for moving the bridge, raising and lowering of the lowering device, trolley travel and raising and lowering of the apron, while another cabin is located at the trimming belt conveyor from which the latter is controlled and signals given for starting and stopping loading operations and movement of the bridge, trolley and lowering device.

New Oil Terminal for Port of Granton

The third announcement within four months of different stages in the development of storage and distribution facilities to keep pace with a growing demand for its products was recently made by the Regent Oil Co. Ltd. The first was of the intention to proceed with the construction of an ocean oil terminal at Cardiff docks at a cost of £500,000; the second was the official opening of a depot at Hendon Dock, Sunderland with a storage capacity of 2 million gals. This scheme was completed in only nine months. The latest announcement is of a terminal at Granton Harbour, Edinburgh which is also expected to cost £500,000.

The new terminal will occupy an area of 12 acres on land owned by Granton Harbour Ltd., and is situated on the south side of the Firth of Forth 1½ miles west of Leith, the main port of Edinburgh. It is strategically placed between two main petroleum consumer centres, Edinburgh and Glasgow. Construction will be directly controlled by Regent engineering staff and it is anticipated the work will be completed early in 1961.

Storage facilities will be provided for 30,000 tons (over 8 million gals.) of petroleum products and some 3,000-ft. of pipelines will connect the ocean tankships berthing at the West Pier with the terminal. Tankers up to 18,000 tons will be accommodated. Piping, pumping, heating and fuelling facilities for road and rail transport for both light and fuel oils will be installed. There will be an office block and staff

messroom and servicing and washing bays will be built to cater for the company's own transport.

Considerable investigation and surveys were carried out in order to find the most suitable location for the new terminal. Regent Oil Company states that the British Transport Commission gave every possible co-operation in considering the extension of the existing terminal at Grangemouth and attempting to find a satisfactory site to accommodate ocean tankers and provide sufficient acreage for the necessary expansion. The volume of passenger and general cargo traffic has so increased at Grangemouth, however, as to make it impracticable to continue to receive petroleum shipments. It is anticipated that when completed, most of the Regent Oil Company staff at Grangemouth will move to the new terminal.

The Use of Radioactive Isotopes for the Study of Littoral Drift

Importance of Accurate Investigation of Coastal Currents*

By J. J. ARLMAN (a), J. N. SVASEK (b) and B. VERKERK (c)

Introduction

The movement of sand and mud by water currents has been a factor of vital importance to man's settlements on the coasts since the earliest times. As a result of silt accretion from rivers and ocean current, harbours like Pisa and Bruges have come to lie far inland, whilst others, whose names are now scarcely remembered, such as Reimerswaal, have been undermined by erosive currents and have vanished into the sea. Others, too, have been preserved from the consequences of coastal detrition and siltation by human intervention. An illuminating example is Venice, of which the story goes that, by diverting the course of the River Brenta, which threatened to silt-up the lagoon, it was able to preserve its strategic position as an island city and port—at the expense of its vassal township Chioggia. However, we do not need to look so far back for examples of works for controlling sand and mud movements. The position of the Netherlands largely depends on such works, whether they concern land reclamation, as in the north of the country, or, as in the south-west, the protection of the coast and the keeping open of waterways by piers, groynes, etc.

It may well be that the execution of the Delta Project will call for new and extensive works of this kind. The envisaged damming of the estuaries (Fig. 1), already begun, will reduce the length of the dykes to be defended against the tides from 1700 to about 1350 kilometres. At the same time, however, the damming will cause drastic changes in the hydrographic situation of this coastal area, particularly in the "underwater delta" adjoining the mouths of the estuaries. The currents in and out of the mouths, at right-angles to the coastline, will largely disappear, but the remaining currents parallel with the shore will bring about sediment displacements different from those known hitherto. The resultant change in the depth contours will in turn alter the configuration of the currents and also the wave phenomena, so important to sand and shingle movements, on the coast. The altered situation must at all costs be prevented from leading to the undermining and disintegration of the sand-dune foreshores, or blocking of the inlets to the Westerschelde and Rotterdam waterways.

The expected changes in sand movements along the south-west coast can be predicted to some extent on theoretical grounds. The picture presented by such predictions is not unfavourable, but the uncertainties involved are very considerable, but the uncertainties involved are very considerable. The transport of sediment, which takes place partly on the river and sea beds and

partly in the water itself (where sediment particles are present in suspension) is a much too complex phenomenon for exact calculation, being governed not only by permanent and quasi-permanent two-dimensional currents and by wave action but also by local disturbances, turbulence, the Coriolis force and, at bends, by centrifugal forces. Again, the configuration of currents and waves themselves, being determined by numerous factors including the tides, fluvial discharges, differences of density in the water and winds, is something that can only be learned from measurements¹.

For the purpose of the Delta Project it was therefore necessary to make an extensive and largely experimental study of littoral drift in the coastal areas concerned. The investigations are in part being carried out on scale models in hydrological laboratories. A large model of the Haringvliet (horizontal scale 1:150), which will be the first of the sea inlets to be closed, has been the subject of experiments for some considerable time now at De Voorst, and another model, covering a coastal belt from the Haringvliet to beyond the mouth of the Rotterdam Waterway (horizontal scale 1:800), was completed and taken into use in 1958 at Delft. Moreover, since various factors, such as wave action, cannot be simulated exactly in such models, "field experiments" are being carried out during the Delta works and will be continued after their completion. These experiments fall into three categories.

First, the causes of the sand movements are measured, namely currents and waves (which must also be known for other reasons). The measurements are made at fixed times in numerous places simultaneously, and constitute snapshots, as it were, of the current and wave conditions (height and spectral distribution of the waves) prevailing at given instants in the entire region under investigation. Extensive use is made of modern methods, such as the automatic transmission by radio of recorded data from fixed measuring points to an information centre (telemetering) and charting the position of test boats, freely drifting rafts and even of wave crests by means of an 8 mm radar installation².

The second category of measurements concerns the consequences of the sand movements: in a number of 500 metre strips along the coast extending from the foreshore to a depth contour 10 m below the mean sea level (Amsterdam datum level) (Fig. 2), changes of the coast profile are studied from monthly soundings and analysed samples of bottom sediment.

* Reprinted by kind permission from Philips Technical Review, Vol. 21, No. 6, March 1960.

(a) N.V. Philips-Duphar Isotope Laboratory, Amsterdam.

(b) Rijkswaterstaat, Delta Authority, The Hague. The Rijkswaterstaat is a national body responsible for canals, drainage, water conservancy and coastal protection.

(c) Now at the Netherlands Reactor Centre, formerly of Philips Research Laboratories.

¹ For a further discussion of this question see the Delta Authority's Progress Report of June 1957 (also published as Technical Memorandum No. 105 of the Beach Erosion Board, March 1958): J. J. Arlman, P. Santema and J. N. Svasek, "Movement of bottom sediment in coastal waters by currents and waves; measurements with the aid of radioactive tracers in The Netherlands." Many of the considerations and experiments described here are discussed at greater length in this report.

² A similar 8 mm system is described in: J. M. G. Seppen and J. Verstraten, An 8 mm high-resolution radar installation, Philips tech. Rev. 21, 92-103, 1959/1960 (No. 3). A provisional communication on the use of radar in this connection will be found in the quarterly report "Deltawerken" No. 4, May 1958, pp. 11-19 (in Dutch).

Measurement of Littoral Drift—continued

In the third category the actual process of the sand movement is measured directly. This was made a practical possibility by a highly effective measuring technique developed during the last decade or so, and based on the use of radioactive tracers. When the sand at a particular site of the river or sea bed is "labelled" with such a tracer it is possible, owing to the high sensitivity inherent to radioactive measuring techniques, to detect some time later the presence of radioactivity in the sand at fairly considerable distances from that site, and in this way to track the movement of the sand. Quantitative data on sand transport can be obtained in this way. Details of this method and the problems it involves, some of which have been jointly investigated by the Delta Authority under the Dutch Rijkswaterstaat and the Isotope Laboratory of N.V. Philips-Duphar, will be discussed in the present article.

Other and essentially simpler methods exist for directly measuring littoral drift. There is the "Sfinx" meter for the movement of bottom sediment and the "Delft flask" for the transport of particles in suspension, both based on the collection of moving sand in a calibrated vessel.¹ The results obtained with these and similar contrivances show very wide spreads, however, partly because the setting-up of the instrument affects the local state of flow in a manner that is difficult to ascertain. A further drawback is their limited usefulness in rough weather, precisely when sand movements may be most pronounced.

Principle of the method

A physical or chemical process in a given material can be investigated by means of a "tracer" of any kind, provided the tracer behaves in regard to the process in the same way as the material in question. In our case, then, the tracer must be a granular material that is transported by water in the same way as sand, or, to be more exact, as the sand found in the coastal area of the Delta works.

Supposing we already have such a tracer, the method of going about the measurements will be roughly as follows. A quantity of the tracer, possibly mixed beforehand with the ordinary unmarked sand, is carefully dumped at a given moment on to a certain site of the sea bed. Currents and wave action will now spread out this "tracer bed" over a large area. The requirement is that the tracer should later be detectable up to a distance of say, 1,000 metres from the dumping site. For the sake of argument we assume that the tracer has spread uniformly over a circle of 1,000 m radius, thereby mixing with unmarked bed material to a certain depth d of, say, 10 cm. In that case the tracer concentration has been diluted by an amount of 300,000 cubic metres of unmarked sand.

Plainly, then, the measurements must be extremely sensitive in order to detect the tracer, and in our case, therefore, only radioactive tracers enter into consideration². Even then, using the most sensitive of detectors, it remains necessary to work with enormously high levels of radioactivity. The following rough calculation will make this clear.

Because of the admixture with inactive material up to a fairly considerable depth (d), the tracer material used must be a radioactive isotope that emits radiation of great penetrating power, e.g. gamma rays of 1 MeV or higher. The best detector for such hard radiation is the scintillation counter, using, for example, an NaI crystal⁴. This counts a substantial fraction of the hard gamma quanta incident on the crystal (the counting

efficiency η may be 35%), and discriminator circuits can be used to reduce the nuisance of background radiation. The measurement is carried out with a set-up such as illustrated in Fig. 3. The counter, containing a crystal of e.g. 2.5 cm diameter is positioned at a distance of, say, 20 cm above the sea bed. In every cubic centimetre of bed material there are n radioactive grains, each with an activity of a microcuries (1 microcurie corresponds to the activity of 10^{-6} grams of radium, i.e. 3.7×10^4 disintegrations per second), and the isotope emits p separately detectable gamma quanta per disintegration. The detector then has a count rate of

$$C = 3.7 \times 10^4 \times 60 \text{ } \pi n a \eta G \text{ pulses per minute. (1)}$$

The factor G is a "geometry factor" which takes into account the dimensions referred to above, the semi-angle φ subtended at the apex of the cone of radiation reaching the counter and which we take to be, say, 45° , the depth d in the sea bed over which the radioactive grains are distributed, and finally the absorption suffered by the radiation on its way to the counter. For a given radiation and at $d=9$ cm, the count rate has been calculated in this way¹ as

$$C = 7 \times 10^6 \text{ } n a \text{ pulses per minute.}$$

With the scintillation counter a background of about 300 pulses per minute is measured and for radioactivity to be detected with certainty it must give a count rate of at least 50% of the background, i.e. in the present case 150 pulses per minute. This means we must make $na \geq 2 \times 10^{-5}$ microcurie/cm³; if the tracer is diluted by 300,000 m³, as assumed above, the total activity required at the dumping site is about 6 curies (corresponding to 6 grams of radium). If the tracer is mixed to a greater depth, say $d=1$ metre, the figure is much higher, in the present case about 40 curies.

There are many other requirements to be met by the tracer material, important ones being the half life of the isotope, the activity per grain and the nature of the grains. We shall return to these presently. The fact, however, that the measurements would involve such very high levels of radioactivity made it desirable to investigate at an early stage⁵ the methods to be adopted in performing the measurements and in handling the tracer material, and above all to consider carefully the means of effectively safeguarding the personnel against harmful radiation. It was therefore decided that Delta Authority engineers, in co-operation with Philips-Duphar, should first carry out a preliminary experiment in the De Voorst hydrological laboratory, which is situated on sandy ground unsuitable for cultivation in the North-East Polder near Vollenhove. A brief description follows of the experimental arrangements and procedures.

Preliminary estimates were of course made of the radioactive contamination likely to be caused by the coastal measurements—in nearby bathing beaches and fishing waters. The dose rates to be expected in these places were calculated from the above-mentioned degree of dilution and from data on the half-life and activity per grain of tracer material (see end of article). On the strength of these calculations, and having regard to the safety requirements—which were made about 1,000 times more stringent than in former experiments of this kind elsewhere⁵—the proposal to perform the measurements along the coast was approved by the Inspectorate of Public Health and by the Isotope Committee of the Royal Netherlands Academy of Science.

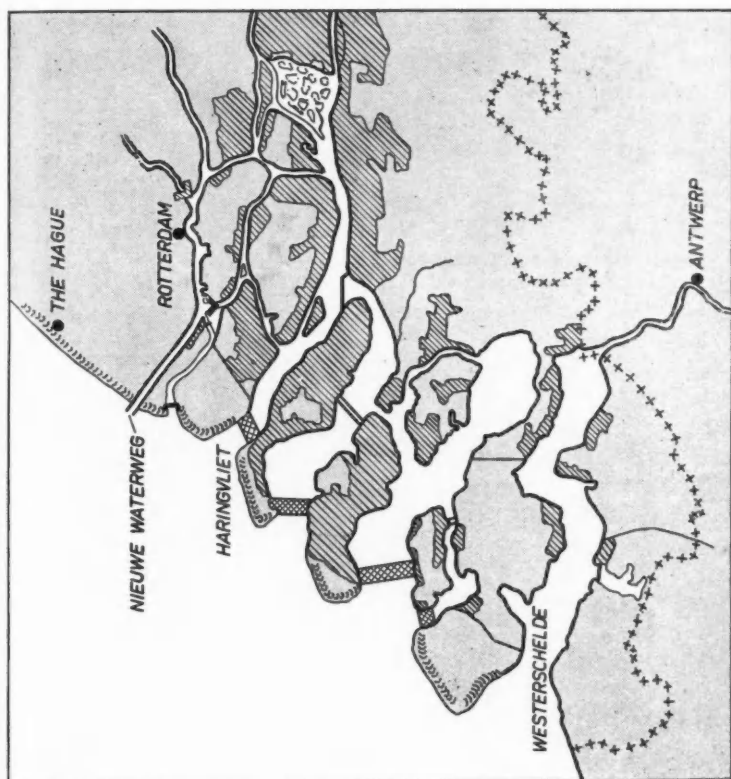
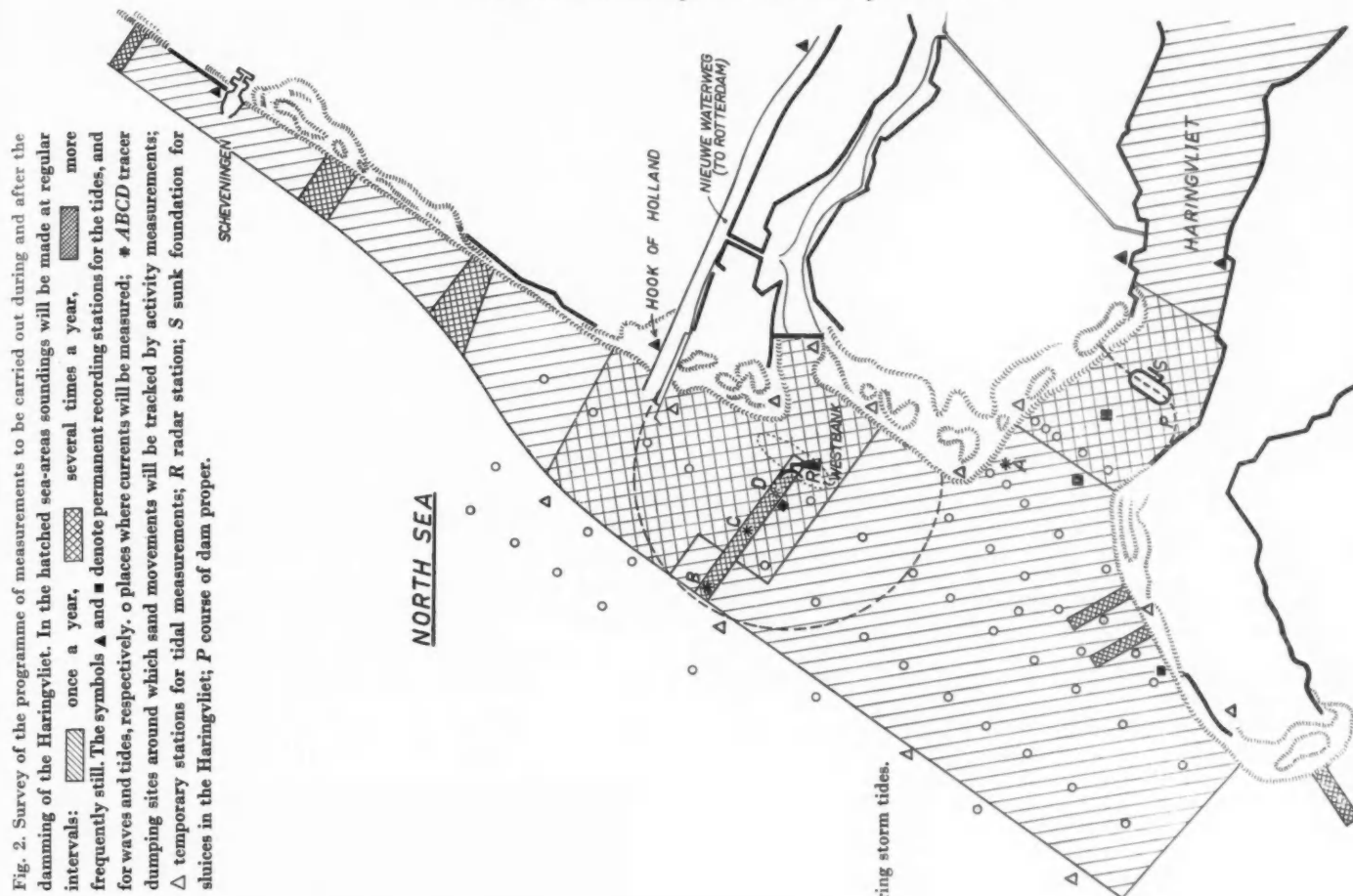
Preliminary experiment in the North-East Polder

The preliminary experiment was made in an "artificial river" specially designed for studying sand and silt movements. The river consists of a straight channel 39 m long and 2.5 m wide, with brickwork banks and sandy bed and with adjustable weirs at both ends for varying the water level and the rate of flow

¹ In principle the tracer used can also be a substance that differs from sand in its chemical or mineralogical properties, in its colour, or in its property of fluorescence. Quite apart from the inadequate sensitivity of these methods of analysis when the tracer is diluted to the extent mentioned above, or the expense involved, a drawback of such tracers is that samples from the sea or river bed have to be taken (which is not necessary with radioactive tracers). This makes measurements at numerous points a laborious and time-consuming process. Furthermore, repeated measurements in the same area are not possible with such tracers, since the tracer properties of the material remaining behind in the sediment (although very diluted) do not decay as is the case with radioactive tracers. See the account of the measurements below (pp. 160-166).

⁴ See e.g. J. A. W. van der Does de Bye, The scintillation counter, Philips tech. Rev. 20, 209-219, 1958/59 (No. 8).

⁵ J. L. Putman, D. B. Smith, R. M. Welles, F. Allen and G. Rowan, Thames siltation investigation, preliminary experiment on the use of radioactive tracers for indicating mud movements, Joint A.E.R.E.-D.S.I.R. report, Wallingford, Dec. 1954.



Legend for Fig. 1:
 Sand dunes along the coast.
 Projected dams closing the estuaries.
 Storm gate in the Hollandse Yssel.
 Storm gate in the Oude Maas, open during storm tides.
 Dams needed for implementing the coastal protection works.
 Dams designed to improve the estuary conditions.

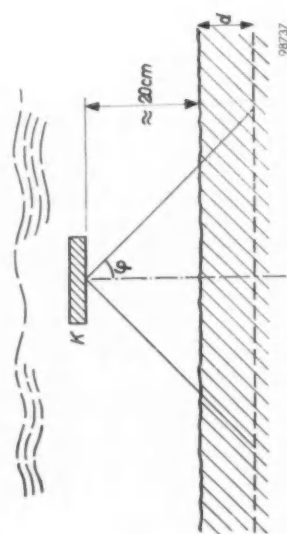


Fig. 3. Detection of bottom-sediment radioactivity by means of a submerged scintillation counter (NaI crystal K). It is assumed that the tracer is uniformly mixed with the inactive sea sand over a depth d .

Measurement of Littoral Drift—continued

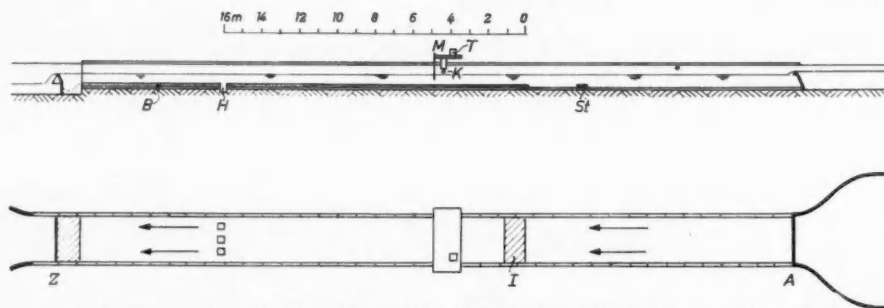


Fig. 4. Cross-section and plan of the artificial river built at the De Voorst hydrological laboratory in the North-East Polder. *A* water inlet, *Z* water outlet, *B* sand bed, *I* site where tracer material was dumped, *M* sliding bridge with scintillation counter *K* and instruments *T*, *H* sand traps for independent determination of sediment movement. At *St* a standard sample of tracer material was fixed and measured simultaneously during each test run, in order to allow for the gradual decline in tracer activity.

(Fig. 4). A scintillation counter, surrounded by a 300 kg lead shield to reduce interference from undesired radiation, was suspended from a wooden bridge capable of being slid along the banks. On top of the bridge were mounted the pulse-counting equipment (Fig. 5), a dip-stick for reading the water level above the bed and a tube for drawing up samples of bottom sediment.

When the experiment was planned, similar experiments had already been carried out at two other places. The first concerned an investigation of siltation in the Thames, and was made by members of the Atomic Energy Research Establishment, Harwell, in collaboration with the Port of London Authority⁵. Almost concurrently, Japanese investigators studied littoral drift along Hokkaido Island with a view to the building of a large harbour near the town of Tomakomai⁶. Since there was no possibility of suitably making sand grains themselves radioactive, use was made in both instances of powdered glass in which a radioactive isotope was fused (in England scandium, ⁴⁶Sc, and in Japan zinc, ⁶⁵Zn). Although it was to be predicted that the transport characteristics of glass grains would differ considerably from those of sand grains, a similar tracer was nevertheless chosen for our preliminary experiment, namely glass beads. In this case, however, instead of fusing an artificially radioactive substance into the glass, the glass beads were themselves made radioactive by irradiation in a nuclear reactor. Under neutron bombardment the radioactive isotope ²⁴Na is produced from the sodium in the glass; this isotope emits very hard gamma rays (1.38 and 2.76 MeV), and has a half-life of about 15 hours. This half-life is much too short for the large-scale investigations in the Delta area, where some measurements will extend over several weeks. For the preliminary experiment, however, a short half-life was just what was wanted in order to avoid the danger of prolonged radioactive contamination of the laboratory premises.

The tracer material was obtained by irradiating fifteen small aluminium cans, each containing 128 grams of glass beads, in the Dutch-Norwegian nuclear reactor at Kjeller, near Oslo. The irradiation lasted about a week, at the end of which time a total activity of 20 curies was measured (partly from shorter-lived isotopes than ²⁴Na).

Conveying the material from Kjeller to De Voorst was a problem in itself; it had, of course, to be done quickly, in view of the short half-life of ²⁴Na, and at the same time thorough measures of radiation protection were necessary. Air transport was ruled out as too expensive. Road transport was therefore decided on. The containers were enclosed in a lead shield weighing 700 kg, and the truck was manned by three drivers who drove in shifts

all through the day and night. The customs posts at the borders to be crossed (Sweden, Denmark, Germany) had been informed of the plan and gave every assistance to prevent delays. As a result, in spite of a breakdown on the road, there were still 1.5 curies of ²⁴Na left upon arrival at De Voorst.

Elaborate precautions attended the unloading of the trucks. A person standing about three feet away from the unshielded cans would have received in six minutes the maximum permissible dose for a whole week; moreover the special facilities available for handling radioactive material at the place of departure were lacking at De Voorst. The material was unloaded in an improvised dump consisting of a trench 50 metres long, access to which was barred on

three sides by dense shrubs and brushwood. The cans were deposited at marked places a few yards apart so that in subsequent handling there was only the radiation from one can to be reckoned with. The contents of the first can were mixed with a known quantity of sand and water in a concrete-mixer, which was mounted on a plastic sheet for collecting spilt material. With a few simple tools the can could be opened in the mixer by remote operation. The labelled sand was then immediately conveyed to the artificial river and emptied out at the appropriate site (see Fig. 6).

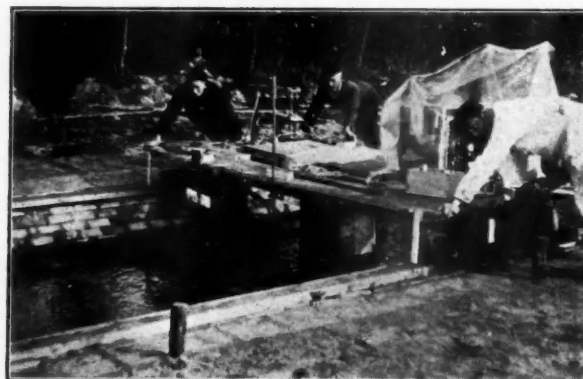


Fig. 5. Bridge with detector and instruments, used for the preliminary experiment at the De Voorst hydrological laboratory.

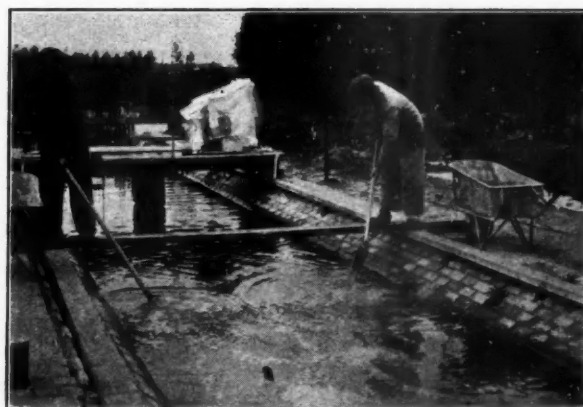


Fig. 6. Dumping the tracer in the artificial river.

⁶ S. Inose, M. Kato, S. Sato and N. Shiraishi, The field experiment of littoral drift using radioactive glass sand, Proc. Conf. Peaceful Uses Atomic Energy, Geneva 1955, Part 15, p. 211.

Measurement of Littoral Drift—continued

This having been done, measurements were made at regular intervals of the distribution of activity along the axis of the channel over a length of about 15 metres. All results were reduced in the usual manner to percentages of a standard sample of the original radioactive material which was measured simultaneously, in order thus to correct for the gradual decline in radioactivity with time. A few hours later the same quantity of sand, labelled with glass beads from the second can, was dumped at the same site, and the activity measurements were then resumed. After 50 hours all the radioactive material had been used up in this way. The measurements were carried out for a total 100 hours from the first dumping.

The results of the activity measurements made at various times over the length of the channel are represented in Fig. 7. The broken curves in Fig. 8 show the rates of transport derived from these results (in litres of bottom sediment per hour), compared with the true rates of transport (full curves) which, because of the simple geometry of the channel, could be calculated from the measured changes in the configuration of the bed. It can be seen from the latter curves that at the beginning of the experiment there was virtually a steady-state movement of sediment; the quantities of sand carried away at the end of the length of channel tested were roughly equal to the quantities supplied to the dumping site. At this early stage, however, the transport of the glass beads clearly lagged behind that of the sand. As mentioned, a difference in this respect was to be expected: the average size of the glass beads was greater than that of the sand grains (D_{50} , that is the value of the diameter which is exceeded by 50% by weight of the material, was 270 μ for the glass beads as against 160 μ for the sand at De Voorst). Moreover the size distribution of the grains was entirely different, and the specific gravity of the glass was 2.95 as against 2.65 for the sand. As can be seen from Fig. 8, after the first 50 hours, when there was no longer a steady-state movement of sediment, but

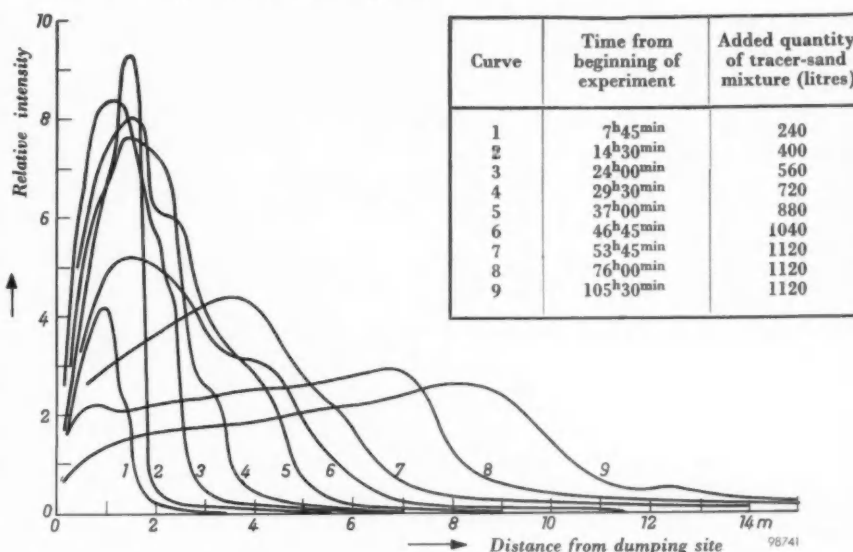


Fig. 7. Tracer activity as a function of distance from dumping site, measured at various times along the axis of the channel (fresh tracer material being added at regular intervals; see inset table).

bed erosion or "scour" had set in, transport of the glass beads occurred. Previous to this, they had evidently largely remained behind with the larger of the sand grains.

Apart from giving a clear idea of the errors to be expected if the tracer material does not possess the same transport characteristics as the sand, the experiment demonstrated that the measuring technique employed can yield useful information on the distribution of radioactivity present in a given area, even when the activity is low (after 100 hours there remained only 1.5% of the original activity).

Numerous measures were taken to protect the personnel against radiation during the experiment. The radiation hazards involved in the various operations were checked by systematic monitoring. In some cases, for example during the operation of the concrete-mixer and when dumping the active sand, continuous monitoring was adopted. All persons engaged in the tests, including some unskilled workers, were of course thoroughly instructed on procedure beforehand. All wore film badges for checking the total received dose, and those most exposed also carried pocket dosimeters⁷ for measuring dose rates at appropriate moments. The area in which radioactive material was handled was plainly marked off by warning signs, and persons unconnected with the experiment were not allowed to enter. Radioactive contamination of the ground near the concrete-mixer could not entirely be avoided, but since the personnel wore either clogs or gum-boots which were left behind at the end of the day, no radioactivity was trodden outside. Moreover, the short life of ²⁴Na meant that all contamination of the premises had disappeared after about a week.

At the end of the experiments it was found that only a few persons had received a total dose in excess of 100 milliroentgens. The highest dose was 160 mr, received by those who had worked 3 days for 8 hours a day. At that time the permissible weekly dose was 300 mr.⁸

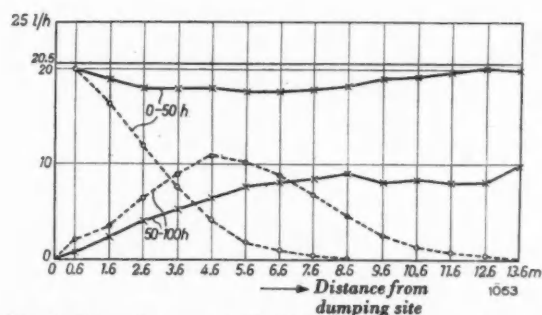


Fig. 8. Rate of transport, in litres of sediment per hour, at points along the axis of the channel in the first 50 hours of the experiment (during which fresh tracer material was repeatedly added at an average rate of 20.5 l/h) and in the following 50 hours (during which no further tracer was added). The broken curves are derived from the activity measurements, the solid curves from the changes in the configuration of the bed. The transport characteristics of the tracer (activated glass beads) differ considerably from those of the sand. This is particularly evident from the curves for 50-100 hours, which, in the first 6 metres, show a larger rate of transport of radioactive material than corresponds to the actual rate of sand transport there: initially, in this first 6 metres or so, the tracer grains were hoarded up, as it were, and only released when there was not much normal sand left over.

⁷ See e.g. N. Warmoltz and P. P. M. Schampers, A pocket dosimeter, with built-in charger, for X-radiation and gamma radiation, Philips tech. Rev. 16, 134-139, 1954/55.

⁸ The weekly permissible dose has since been reduced to an average of 100 mr, but peaks are allowed provided that the total dose received in 13 weeks does not exceed 3 r.

Measurement of Littoral Drift—continued

Labelling the sand for measurements on the coast

As we have seen, the simple method of using activated glass beads is not suitable for the definitive measurements. The half-life of ^{24}Na is also far too short. What is wanted is a half-life of the order of one week to a month; there is then sufficient time to carry out measurements extending over a few weeks, whilst on the other hand the activity decays quickly enough to avoid any cumulative contamination of beaches or interference with subsequent measurements in the same area.

Direct activation of a quantity of sea sand, by irradiation in a nuclear reactor, would be the ideal way of ensuring completely identical behaviour of the tracer in regard to its transport by currents and waves. In particular there would then also be a reasonable certainty that each grain had received an activity proportional to its weight; in that case the measured activities would be a direct measure of the displaced quantities of sand by weight, irrespective of the segregation between grains of different size that may occur during displacement. Unfortunately, for our purposes the elements present in sea sand either produce isotopes of too low an activity or they lead merely to beta emitters, whose radiation is not penetrating enough, and which moreover are short-lived. It was therefore necessary to look for a suitable radioactive isotope, and to find a means of bonding it or incorporating it chemically in sand, or in a substance sufficiently like sand for our purpose.

An investigation into the possibly suitable isotopes led to the choice of ^{46}Sc . This has a half-life of 85 days and emits two gamma quanta, one of 0.89 MeV and one of 1.12 MeV. The presence of two radiations of different energy can be an important advantage, for in principle it is then possible, by virtue of the different absorption of these radiations in the bottom sediment, to deduce from the measurements information on the activity distribution in a vertical cross-section of the sea bed. (This implies, however, that the semi-angle ϕ in Fig. 3 would have to be rather small, which would reduce the sensitivity of the activity measurements.)

The isotope ^{43}Sc , from which the active ^{46}Sc is formed by neutron-capture, has an effective cross-section for this process of 22 barns; this is a relatively high value, and means that when a quantity of the material is irradiated in a nuclear reactor a quite considerable activity per unit weight can be produced. In view of the high total activity needed in our case (as mentioned above, as much as 40 curies may be required) this is a favourable circumstance, for there is only limited space in a reactor for the parent material and strongly radioactive materials become more difficult to handle as their volume increases.

There is no known method of bonding ^{46}Sc to grains of sand⁹. An effective and economical alternative, however, is to bond the isotope to an inorganic ion-exchange substance. In connection with their normal function—the binding of ions from a solution which is passed through a column packed with the ion-exchange material—the ion-exchange substances are prepared in the form of grains. Some have grains of nearly the same size as the sea sand with which we are concerned. Furthermore, the exchangers are capable of binding ions of trivalent scandium so strongly that subsequent exchanges with monovalent or divalent ions in sea water are negligible. For that reason substances of this kind, particularly of the clayish zeolite group, are in fact used for “cleaning-up” the radioactive waste from nuclear reactors, which is deposited at inaccessible places. One of the zeolites known as “green-sand”, which is commercially available as “Ionac C 50”, has a density (2.72-2.76) close to that of North-Sea sand (2.65-2.68) and it can readily take up the

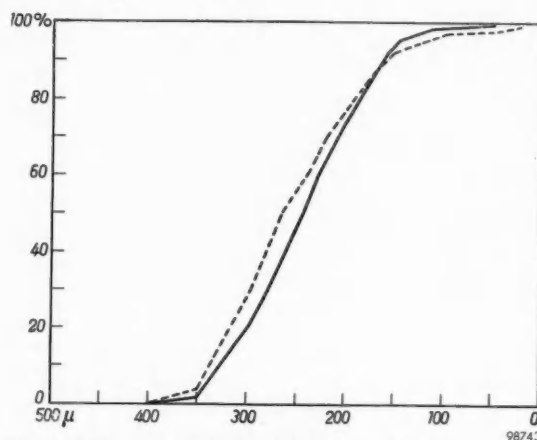


Fig. 9. Solid curve: grain size distribution of a given mixture of sand and fired “Ionac C 50” (the ion-exchange substance in which the radioactive isotope ^{46}Sc is absorbed), plotted as the percentage by weight of grains larger than the value on the abscissa. Broken curve: the distribution after the mixture, suspended in water, had been shaken up for 10 hours in a concrete-mixer. There is scarcely any change in the distribution, indicating that there is virtually no erosion of the fired Ionac C 50 grains by the sand.

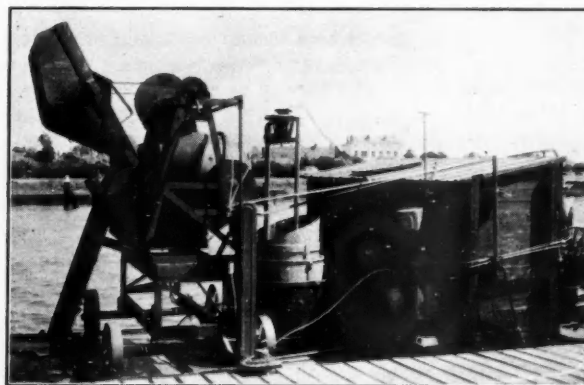


Fig. 10. Plant installed on a barge for preparing the tracer material¹⁰. An ampoule containing radioactive ^{46}Sc , prepared in a nuclear reactor, is broken open and the contents dissolved in nitric acid in a vessel (not visible in the photograph). The solution is neutralized and diluted with water, after which it is conveyed by compressed air to the mixer shown on the left, which contains the appropriate quantity of “Ionac C 50”. After some hours of mixing the ^{46}Sc is distributed uniformly enough amongst the grains. The contents of the mixer are emptied into the container on the right of the mixer, in which the tracer material is conveyed to the dumping site. The large bunker on the extreme right is filled with sand to protect workers on the barge against radiation. The whole installation is remotely controlled from behind this bunker.

necessary quantity of scandium.

The take-up capacity of Ionac C 50 cannot by any means be used to the full. Indeed, the activity per unit weight of tracer, that is to say the activity per grain of zeolite, must not be unduly high. There are two reasons for this. Firstly, they must not be injurious to humans or fish that may swallow some. Secondly, the activity must be carried by so many grains that even in the most diluted state of the tracer the statistical fluctuations in the number of grains present in the “field of view” of the scintillation counter will remain sufficiently small. Referring back to the foregoing calculation (see formula (1) and discussion following it), we can put the required number of grains for one measurement at 100. At the beginning of the experiment described we

⁹ This has, however, proved possible with ^{140}Ba , an isotope that might also be used for this purpose inasmuch as its daughter product ^{140}La emits hard gamma quanta. See D. B. Smith and J. D. Eakins, *Unesco Conf. Radio-isotopes in sci. Res.*, Paris, Sept. 1957, paper No. 63.

Measurement of Littoral Drift - continued

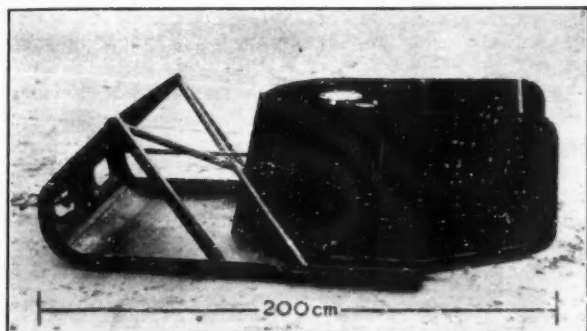


Fig. 11. Sled on which the scintillation counter and its shielding are mounted, and which is towed over the sea bed by a flat-bottomed boat. It is connected to the instruments on the boat by a 6-core cable.

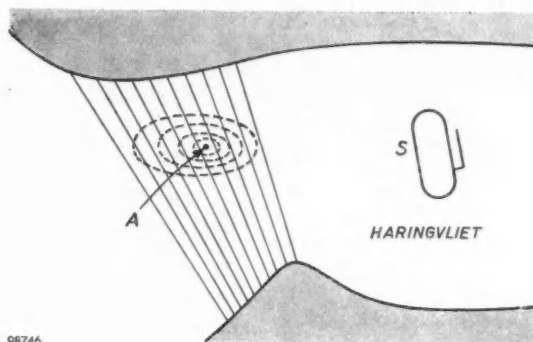


Fig. 12. Leading lines in the Haringvliet, defined by markers on the shores. The tracer material was dumped at A. The boat, while detecting and recording the radioactivity continuously, is steered as closely as possible along these lines so that with only one angular measurement a fix can be obtained on its position. The contours of equal activity, shown here by dotted lines, are determined by combining the results of all measurements taken at various times. This system of navigation has since been superseded by the "Decca Survey System", which is much more accurate.

should then need a total of approximately 2.5×10^9 grains. If the average grain diameter is 200μ this means that the total initial activity of about 6 curies must be contained in at least 25 kg of the ion-exchange substance.

The activity per grain is then low enough not to cause any harm to fish, even though they may swallow large numbers of the widely dispersed grains. Sea bathers would have to consume kilograms of sea sand before their activity intake from the tracer in its ultimate dilution reached the permissible level. A fortiori the activity to which bathers lying on the beaches might be exposed is far below the permissible limit.

One difficulty, which typifies the whole experiment, was that the grains of Ionac C 50 are softer than the sand grains in which they are mixed. During the movement of sediment over the sea bed the grains are therefore eroded by the sand, their size distribution changes rapidly, and the resultant segregation again causes the transport properties of the tracer to differ excessively from those of the sand. It is possible, however, to make the Ionac C 50 grains harder by firing the material at 750°C . The capacity of the fired material to absorb ^{45}Sc , and the rate at which it does so, are still sufficient, allowing the active isotope to be added to the Ionac C 50 after firing, which is of course the easier procedure; the limited activity required per grain is absorbed in about 2 hours (the unfired grains absorb the same activity in 3 minutes). The fact that firing adequately reduces the erosion is demonstrated in Fig. 9: a mixture of fired Ionac C 50 and quartz sand was shaken up for 10 hours in a concrete-mixer,

and the results show that the size distribution of the mixture remained reasonably constant. After the Ionac C 50 had been stirred in sea water for 48 hours, it was not possible to detect any drop in ^{45}Sc activity.

The measurements in the Delta coastal area are therefore being carried out with this tracer material.

The coastal measurements now in progress

In April 1958, trial measurements were made in the mouth of the Haringvliet (the tracer being dumped at point A in Fig 2). These provided an opportunity to test the method in the field, and at the same time yielded the first data on sand movements in this area, which is of particular importance to the Delta Project at the present stage.

Before the tracer material was dumped the area was scanned for radioactivity in order to determine the background to be allowed for during the measurements. This brought to light a number of unsuspected facts. The sand on the sea bed was found to possess much higher natural radioactivity than the sea water. This activity appears to be concentrated in the heavy minerals, which constitute from 1 to 5% of the sand, and thought to originate from uranium or thorium inclusions in the mineral zirconium. Moreover, the background count rate from the sea bed differed considerably from place to place; the average background is about 200 counts per minute, but at some points it rises to 500 per minute. Even before the actual measurements (with the artificial tracer) were begun, therefore, it was possible to draw certain conclusions concerning sand movements, viz. to deduce at what places a relatively high content of heavy minerals and coarse grains of sand are deposited.

For introducing the radioactive isotope into the appropriate quantity of carrier material, an installation was erected on a barge; a photograph of the installation is shown in Fig. 10 and particulars are given in the caption¹⁰. The prepared material is deposited at the planned position from a small craft by means of a specially designed container, provided with a shield, which is let down vertically on to the sea bed to prevent the discharged material from being dispersed by the current before it has had time to settle.

The activity detector (a scintillation counter), properly shielded is mounted on a sled two metres long (Fig. 11), which is towed over the sea bed by a flat-bottomed boat. The detector thereby maintains automatically a constant distance of 20 cm above the surface of the sand (Fig. 3). On board the boat are a count-rate meter and recording unit, together with a power supply unit which provides the 1,700 to 2,000 V constant potential for the detector. All this equipment is fed from a 220 V A.C. generator and is connected to the detector sled by a six-core cable.

The accuracy of the whole method is determined partly by the accuracy with which a fix is obtained on the position of the detector sled. Originally the boat was navigated as well as possible along a leading line defined by markers along the shores (Fig. 12), and a fix of the boat's position on this line was obtained by means of a sextant. The Delta Authority now has at its disposal an apparatus for radio navigation, the "Decca Survey System", which was first used in 1944 during the Allied landings on the coast of Normandy. The system uses hyperbolic co-ordinates determined by three transmitters—situated at Rilland-Bath, at Sluis and at Schipluiden—and the navigator can fix his position in these co-ordinates from the readings of two indicating instruments on board the boat¹¹. Within the estuaries this system has an accuracy of 3 to 4 metres, and outside them of 5 to 8 metres; with the old system the error in the fix could be as much as 20 metres. The position of the sled in relation to the boat is calculated from the length and sag of the towline and from the depth of the water, a correction being applied for the effect of the current.

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¹⁰A description of the procedures in the field is given in quarterly report "Deltawerken" No. 6, Nov. 1958, pp. 22-28, from which figures 10-12 have been taken.

¹¹Quarterly report "Deltawerken" No. 7, Feb. 1959, pp. 5-10.

East African Railways and Harbours

Extracts from Annual Report for 1959

The annual report for 1959 of the East African Railways and Harbours was published recently and abstracts from the sections dealing with harbours are given below. The full Report of 64 pages, price 5s. is obtainable from the General Manager's Office, P.O. Box 30121, Nairobi, Kenya.

The combined railways and harbours revenue for the year was £24,186,000, an increase of £747,000 or 3.19 per cent over 1958. Harbours revenue accounted for £4,671,000, an increase of £162,000 or 3.60 per cent, mainly due to increased exports.

There was a revision of the Harbours Tariff on 1st October, the object being to encourage shipping to work within the normal port working hours adopted after the Parkin Reports.* Port dues were reduced by 50 per cent and revenue was maintained by the introduction of new charges for accostage (based on time spent alongside deepwater quays) and lighter hire. The ordinary working expenditure for the harbours dropped by £13,000, compared with a fall of £94,000 in the previous year.

[Enquiries were conducted by and under the chairmanship of Sir Ian Parkin, late Manager of the U.K. National Dock Labour Board. His reports recommended, inter alia, that the basic working hours of the ports (except Lindi and Mtwara) should be changed in order to work ships for two full shifts (each equipped with fresh labour and supervisory staff) of 7½ hours on weekdays, with enhanced rates for all overtime, night duty, and work on Sundays or public holidays.

This recommendation was adopted on October 1st and has resulted in significant advantages to all parties. The supervisory, clerical and cargo handling staff have benefitted and the Administration as the Port Authority has been able to make fuller use of the very expensive assets represented by the deep water berths, transit sheds, cranes, etc.]

Mombasa

At Mombasa there was again a new record tonnage for general cargo exports, but there was a sizeable fall in general import tonnage. General cargo exports totalled 866,000 tons deadweight, an increase of 62,000 over the 1958 figure while general cargo imports showed a drop of 28,000 tons, at 596,000 tons. Bulk oil imports rose by 8,000 tons to 979,000 tons, while bunkers and bulk oil exports increased by 23,000 tons to 138,000 tons, these tonnages including cargo transshipments, but excluding coal.

The number of ships, excluding dhows and schooners, entering Mombasa during the year totalled 1,270, 115 more than in 1958. The average tonnage of general cargo handled per ship working day was 546 tons, a decrease of 12 tons per day. Performance during the first part of the year was affected by late hand-over of export cargo, and by loss of productive time during exceptionally heavy rains, but by the end of the year the working level had recovered, and indeed exceeded that for 1958.

Two-shift working was resumed at the lighter wharves, and the lighter fleet was reduced during the year from 32 to 26 effective units, resulting in more intensive use. From August onwards, export cargo collection was concentrated in three sheds to expedite handling. An agreed scheme for "closing dates"

Measurement of Littoral Drift—continued

In June 1959, large-scale measurements were started with the object of ascertaining the present littoral drift near the mouth of the Rotterdam Waterway. A total amount of roughly 300 kg of tracer material, having an activity of about 6 curies of ⁴⁶Sc, was deposited at three points marked B, C and D in Fig. 2. It is expected that the results of these measurements, in conjunction with scale-model investigations, will allow conclusions to be drawn as to the effect which the building of Rotterdam's "Europoort" and the damming of the Haringvliet will have on conditions at the mouth of the Waterway.

for export cargo was introduced on Sept. 1, under which no further export cargo is accepted by the port for a major loading ship during the last 48 hours before her scheduled sailing, a shorter period being applied to the ships loading smaller tonnages.

A port cargo shed was withdrawn from use, for conversion to a passenger and baggage hall, which was opened in September. By the end of the year only residual dredging of berths 7, 8 and 10 remained uncompleted, while renewal of apron surfaces and railway track of berths 2 and 3 began in June, but the latter berth was not operative until mid-December, due to the railway strike. Kipevu berths 11 and 12 were handed over in June followed by Nos. 13 and 14 in October. A survey was commenced in September to determine the degree of dredging required in the channel, and in the harbour to permit the entry of supertankers to the proposed Changamwe oil refinery.

Dar es Salaam

General cargo exports were 33,000 d/w tons more than in 1958 and the total figure of 306,000 constituted an all time record for the port. General cargo imports were slightly more than the previous year at 218,000 d/w tons. The tonnage of transshipment cargo, which is included in the above figures, was 8,000 tons.

The policy of working as much general cargo as possible, both imports and exports, across the Princess Margaret Quay resulted in over 80 per cent being so handled compared with 68 per cent in 1958. Progress in identifying export cargo with specific ships at the time of its arrival at the port enabled economies to be made in the lighterage fleet.

Work on the middle of the port transit shed began in October and it is estimated the shed will be ready for use during the 1960 export season. The additional 105,000 sq. ft. of shed space on Princess Margaret Quay will expedite cargo working there.

Tanga

Total imports of general cargo for the year, excluding bulk oil, were 38,000 d/w tons, of which cement imports aggregated 7,000 tons, less than half the 1958 figure of 15,000 tons. Bulk oil imports were 13,000 tons. Total exports for the year were 151,000 tons, of which 129,000 tons were of sisal. In addition 5,000 tons of cargo were transhipped directly from coastal lighters to ships.

Mtwara and Lindi

At Mtwara there was a slight reduction in general cargo imports, but bulk oil imports rose by 5,000 tons to 11,500 tons. Exports at the end of the year showed an increase of 862 tons over the 1958 figure. As a result of a fall in timber exports of 3,500 tons, this trade is being regarded with some anxiety.

There was little change at Lindi and, at the end of the year, imports were 1,600 tons down and exports showed a rise of 3,000 tons.

Two additions were made to the port equipment during the year. A further mobile crane was allocated and the lighter fleet was augmented by three units of a total capacity of 400 tons. A detailed marine survey was made of the entrance bar of Lindi harbour and of the area surrounding the jetty with a view to ascertaining the extent of silting thought to have taken place since the 1952 cyclone.

Lake Ports

On Lake Victoria good progress was made with the construction of the new port at Mwanza South and the port was substantially completed by the end of February 1960. One of the transit sheds was brought into use during 1959 principally for cotton and wheat traffic. Bulk oil handling facilities were provided at Kisumu and Musoma, and on Lake Albert work continued on the rehabilitation of Butiaba Pier.

Melbourne Terminal for Tasmanian Ferry Service

New Berth with Unusual Features

(Specially Contributed)

The Tasmanian Ferry Terminal established by the Melbourne Harbour Trust Commissioners occupies a 6 acre site of what was formerly low-lying wasteland on the south side of the Williamstown Road, Port Melbourne.

The site was selected because it is right alongside deep water which has been dredged for the Trust's future River Entrance Docks. A plan of the area is given in Fig. 1.

The site was built up by depositing a blanket of quarry waste (which appears as overburden in many of Melbourne's basalt quarries) about 7-ft. thick. After consolidation this blanket formed a very satisfactory foundation for the subsequent works, as most of the area is paved for roads, parking areas and the like.

At the inshore end of the berth steel sheet piling capped with concrete and tied back to buried anchors, forms the wharf face. As work proceeded offshore the foundations became much softer and to obtain sufficient toe resistance for the sheet piles it was necessary to adopt a different type of construction. The line of the wharf face was continued with a reinforced concrete retaining wall cantilevered from a flat slab platform 16-ft. wide supported on piles raked 3.1 (See Fig. 2). Steel sheet piling was driven at the rear of the platform and the platform loaded with sand fill. The weight of the sand fill and platform is carried by the vertical component of the forces in the raking piles and the horizontal component of the forces in the piles is taken by the passive resistance of the filling behind the sheet piling.

Some of the piles which support this platform are over 100-ft long. They are composite piles consisting of a bottom length of a relatively inexpensive timber (usually messmate) to which is spliced a top length of prestressed concrete. The splice was made by turning a cylindrical end on the top of the timber pile to suit a 14-in. dia. M.S. sleeve 4-ft. 6-in. long rolled out of $\frac{3}{8}$ -in. plate and welded along the seam. The prestressed concrete top length was cast into the previously prepared sleeve.

During driving, the head of the timber pile was protected by a metal driving ring which was removed when the head of the pile was almost at ground level. The prestressed top length was then fitted and the composite pile was driven with a special helmet (made out of 6-in. thick M.S. plate) which had holes in it to take 4 dowel rods left projecting from the end of the prestressed pile.

These dowel rods later tied the top of the pile into the reinforced concrete platform. Driving of the pile was stopped when the top of the pile reached the desired level.

After driving, the tops of the piles were roughened and the concrete platform formed and cast.

The ship does not berth alongside the wharf face, but some 60-ft. away. The wharf face therefore is in quite shallow water which deepens out towards the ship.

Three large 16-pile dolphins carry berthing shocks and keep the vessel away from the shallow water.

The "Princess of Tasmania" was built especially for the shipment of passengers and vehicles across Bass Strait.

The passenger reception building (shown in Fig. 3) is tastefully decorated in modern colours with upholstered lounges, whilst amenities include a buffet bar, toilet facilities, telephones and Information Counter (particularly for Royal Automobile Club drivers).

A stairway leading upwards from the Lounge gives the only access to the ship for pedestrians. After passing through a wind lock, designed to restrict the entry of the wind as the outer doors are opened, the intending passenger walks along an overpass which is virtually a grade separation. This is necessary because the area below the overpass includes the access road to a future berth now under construction. By means of the overpass passengers at the one berth and vehicles for the other berth are completely separated.

The passenger finally reaches the ship by passing over one of two light-alloy gangways which span the 8-ft. space between the end of the overpass and the ship's side. Each gangway has two hooks (one each side) which hook over the ship's coaming. Usually such a gangway is made to fit any ship at any point and the two hooks are attached at the same level across the gangway. Consequently, the gangway itself will often have some twist in it due to the ship's coaming not being horizontal. In the present instance, however, the gangways are required only to fit one particular ship at one particular point and as the variation in the angle of the coaming is inappreciable, it is possible to make allowance for the slope of the coaming at this point. The two hooks are therefore mounted on the gangway at different levels, whilst the gangway is always level across.

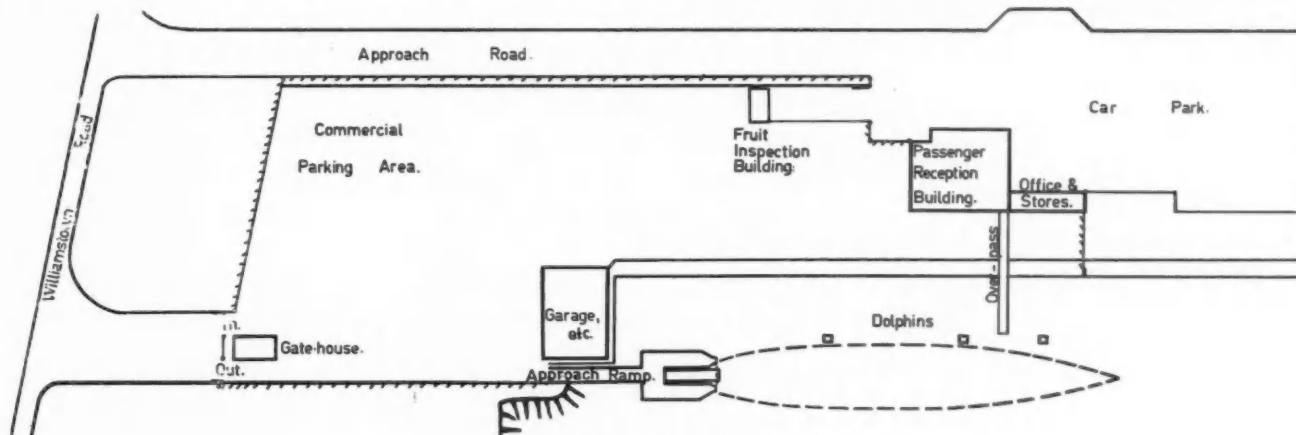


Fig. 1. Detailed plan of ferry wharf.

Melbourne Terminal—continued

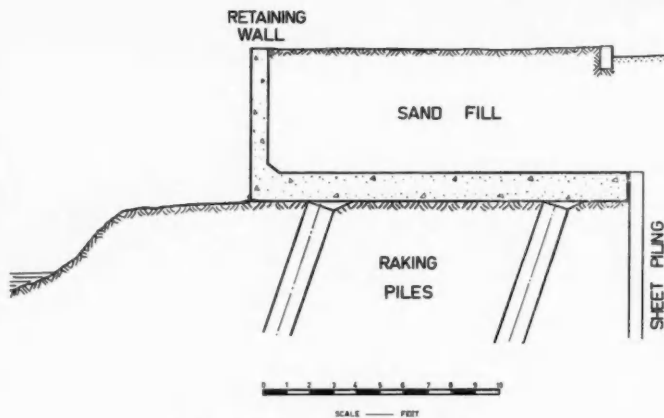


Fig. 2. Cross-section of wharf.



Fig. 3. General photograph showing reception building, passenger overpass and "Princess of Tasmania."

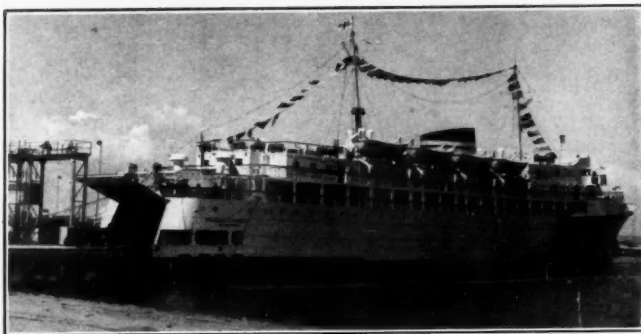


Fig. 4. View of ship from aft.

Vehicles are driven on board through a door in the stern of the vessel (See Fig. 4). After the driver of the vehicle has dropped his passengers at the passenger reception building he proceeds along a well defined roadway past a check gate, where his car is examined by Inspectors of the Department of Agriculture, for it is necessary to take action of this kind to check the spread of plant diseases.

The driver then takes his vehicle past a commercial vehicle marshalling area and the terminal workshop building (to be described later) and on to the vehicle approach ramp, which is the only access to the ship's vehicle deck.

The vehicle approach ramp is supported on timber piles with cast-in place reinforced concrete headstocks. Prestressed concrete planks span the 20-ft. centres between headstocks. The

outer section, which is irregular in shape, is a cast-in place reinforced concrete structure on composite piles.

The tidal range in Melbourne is very small, averaging less than 2-ft., although exceptionally high tides have been recorded during floods in the river, as well as a few exceptionally low tides. The small tidal range and the small variation in draft of loaded and unloaded vessel (2-ft.) simplified the task of designing the loading ramp. Floating pontoons were not required, nor was it considered necessary to make provision for varying the position of the ramp whilst vehicles are actually using it.

Fig. 5 shows a diagrammatic arrangement of the ramp.

It consists essentially of three main sections hinged together as follows:—

- (1) A rigid ramp bridge 40-ft. long, hinged at the shore end, and carrying:
- (2) A link span, 10-ft. long, flexible in torsion, which carries at its outer end
- (3) A 3-ft. wide apron, roughly triangular in section.

Although the link span is of steel its torsional stiffness is very low, and it is sufficiently flexible to accommodate variations in the list of the ship.

The angular movement of the two extensions is limited by stops so that when the ramp is not resting on the ship the extensions are held out in a nearly horizontal position. This is shown clearly in Fig. 5. When the ramp is lowered the two extensions rest on the vehicle deck.

The ramp is supported from a gantry frame with 4 steel wire ropes. When the ramp is in position for the passage of vehicles, a portion of the dead load and all of the live load is taken on two large (3½-in. dia.) locking pins which extend from the ramp into a slotted rack fastened to the concrete wharf structure.

The 4 supporting ropes are arranged 2 on each side of the ramp bridge and each rope makes two 90° bends over sheaves on the gantry frame and is connected to a large concrete counterweight at one side of the gantry frame. The ropes are so arranged that the two ropes from any one side of the ramp go to diagonally opposite corners of the counterweight, so that, if the main ramp bridge has any initial twist, it can be taken out by adjustment of the ropes (see Fig. 6).

While the ramp is being moved and is not in contact with the ship, the aggregate load in the 4 ropes is approximately 18 tons, but when the ramp extensions rest on the vehicle deck, the aggregate load drops to a minimum of only 12½ tons. When the locking pins are extended and the ramp rests on the pins, the aggregate load drops still lower as explained later.

All movement of the ramp is effected by a 3-ton electrically operated winch which supplies the effort to give complete control of the ramp.

The heart of the system is a unique 2-part reinforced concrete counterweight. The bottom counterweight, which weighs 9.3 tons, is permanently connected to the four supporting ropes, whilst the top counterweight weighing 4.7 tons is raised or lowered by the winch. Two parts of rope come off on one side of the winch drum and four parts of this rope easily lift the top counterweight. Alternatively the winch can be used to pull down the bottom counterweight. Two parts of rope coming off the other side of the drum are reeved to give 4 parts on the bottom counterweight, so that an aggregate force of nearly 6 tons is here available. This rope reeving is clearly shown in Fig. 6.

When the ramp is being moved and is not in contact with the ship, the top counterweight is allowed to rest on the bottom counterweight and the 4 tons difference between the aggregate rope force and the aggregate weight of the two counterweights is met by the ropes leading directly to the bottom counterweight. The ramp can then be lowered by paying off on these ropes until the ramp extensions reach the vehicle deck. Further lowering of the ramp bridge, if required to suit state of tide and ship's

Melbourne Terminal—continued

draft, is accomplished by lifting the top counterweight while still paying off on the bottom counterweight ropes. At the appropriate working position of the ramp bridge, the locking pins are extended, and as the bridge is further lowered, some of the weight is transferred to the pins. When the top counterweight is lifted clear of the bottom counterweight, the load in the 4 supporting ropes is then equal to the bottom counterweight (i.e. 9.3 tons) and the difference between this weight and the 12½ tons abovementioned is divided between the two pins, thus ensuring that the ramp is positively supported on the pins and does not bounce under live load.

The winch drum is located directly above the centre of the counterweights and the two counterweights have a large hole in them through which all winch ropes can pass.

As already stated, two pairs of ropes lead off the grooved winch drum (one pair each side) and as these ropes can become unloaded in service, a light cast iron overhauling weight is attached to each rope to maintain tension and prevent it jumping out of its groove. Furthermore, a very efficient rope guard is fitted to every sheave (except the single equalising sheave) so that even although the ropes do slacken off, they will never be displaced out of the grooves.

The winch motor is operated by push buttons (placed on the ramp guard rail) and electrical safeguards are provided to ensure that the correct sequence of operations is followed.

Whilst the locking pins are extended, the ramp cannot be raised more than about an inch. This is to prevent a careless operator from causing damage to the winch ropes and motor by trying to raise the pins above the tops of the slots.

When the pins have been retracted, the ramp may be raised or lowered at will, except that limit switches prevent operation beyond the safe extreme positions.

When it is desired to support the ramp again on the pins, the pins are extended and the ramp is lowered. When the pins touch bottom in the slots the top counterweight begins to rise above the bottom counterweight and this rise is limited to about an inch.

The mechanics of the counterbalancing arrangement is such that friction in the 4 ramp-supporting ropes must be kept to a minimum, otherwise the ramp may not be able to overtake the bottom counterweight. Accordingly, the 8 sheaves over

The mechanism for extending and retracting the locking pins has been adapted from a spring-toggle-operated railway points mechanism. The adapted mechanism contains the following features:—

- (1) The handle can be parked in its slot only when the pins are extended.
- (2) The handle cannot be parked when the pins are retracted, but stands up at an angle to the deck, thus giving a visual indication that the locking operation is incomplete.
- (3) No shock is transmitted to the hand of the person operating the mechanism.

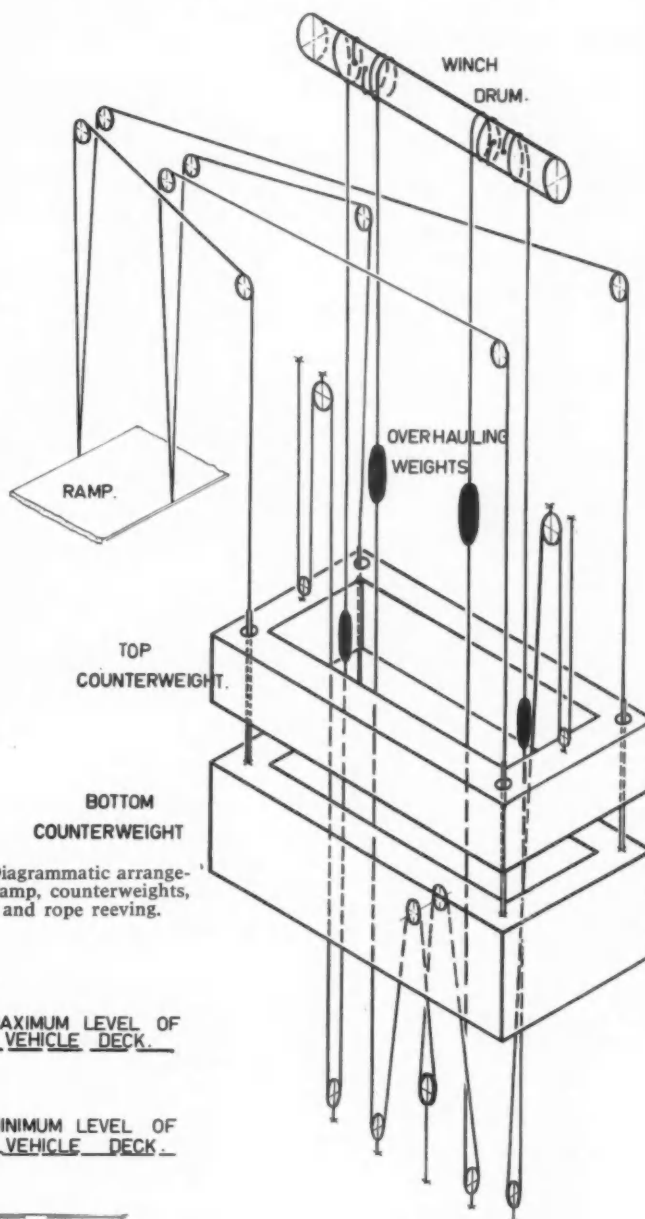


Fig. 6. Diagrammatic arrangement of ramp, counterweights, winch and rope reeving.

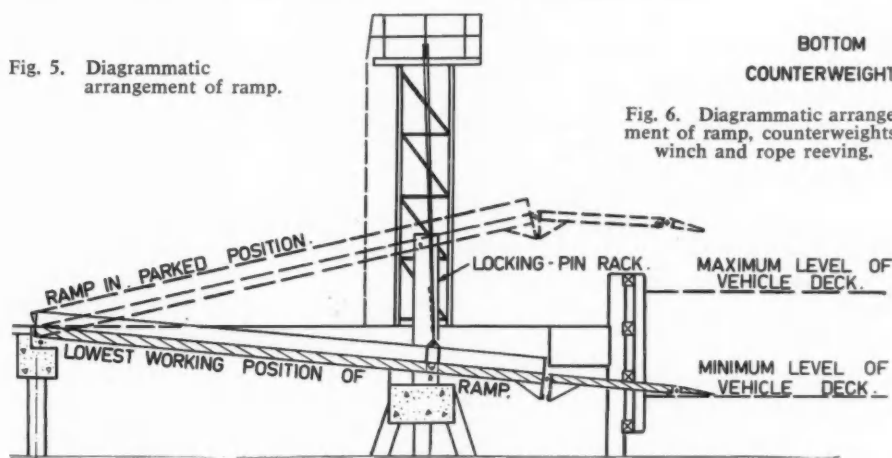


Fig. 5. Diagrammatic arrangement of ramp.

which these 4 ropes pass are provided with roller bearings.

The operating winch drum is driven from a 5 h.p. squirrel cage motor through a double reduction worm drive giving a ratio of about 800 to 1. The speed of the rope is 6-ft. per minute, giving a speed of 3-ft. per minute on the ramp. This speed has been found to be adequate.

Taken all round, the ramp works so smoothly and quietly and with so little effort on the part of the operator that a casual observer could easily not appreciate the complications of the system.

After the vehicle has been driven on board the ship the driver is directed to a parking site and the vehicle is lashed to the deck

Melbourne Terminal—continued

with specially designed quick-acting, easily released lashings which hook on to "blisters" in the deck.

The driver then leaves his vehicle and rejoins his passengers through a companionway inside the ship.

Reference has already been made to the commercial vehicle marshalling area and the terminal workshop building.

The "Commercial" entrance to the terminal is a gate-controlled entrance separate from the passenger's entrance (see Fig. 1). The commercial vehicles are booked in at the gate and they are loaded on to the ship by the terminal staff. As the ship spends most of each second day in port in Melbourne, the terminal staff have only one day in which they must discharge all commercial vehicles carried across the previous night, and load all commercial vehicles for the next trip across the Strait. Most of these vehicles are moved by tractor.

The terminal workshop building contains garage space for all the vehicles and other equipment required. This building contains offices, amenities and toilet facilities for all those working the ship and the terminal. The power requirements of the

terminal are substantial and a substation is located inside the workshop building.

Whilst the ship is in port, all auxiliaries are run by 3-phase A.C. power drawn from the shore supply. The power is taken on board through 4 flexible cables and these cables plug into a receptacle located on the port side near the stern of the ship. When the ship is not in port, the cables are coiled up inside a large metal cubicle which contains all the switches and fuses necessary for protection of the circuits.

Provision is also made for the ship to be able to take in oil and water whilst in port. These services are coupled up on the starboard side of the ship.

One of the first shore services required while the ship is at berth and the last to be removed is the telephone service. This is connected and disconnected at the passenger overpass.

Plans are now in hand for a second berth to be constructed adjacent to the first for the purpose of handling cargo in trailers and containers.

A ship specially designed for this trade is now being built.

National Dock Labour Board

Abstracts from Annual Report for 1959

The 13th annual report of the National Dock Labour Board, which was published at the beginning of this month, states that improvement in the level of employment which commenced in the closing weeks of 1958 and continued into 1959 was not maintained and, by August the demands for labour had fallen to exceptionally low figures, an average of less than 51,000 registered men being employed. However, there was a turning point in mid-August and thereafter labour requirements increased to a more satisfactory level.

Nevertheless the aggregate of normal turns worked during 1959 was only slightly better than in 1958, after making allowance for the additional week which fell within the 1958 accounting year. This may at first seem somewhat surprising as the preliminary Board of Trade figures showed increases of 4 per cent and 6½ per cent in the volume of United Kingdom exports and imports over the 1958 level, but as has been said in previous reports it is difficult to establish a direct relationship between employment and trade figures. However, although the import and export tonnages include the launching of new vessels, overseas deliveries of aircraft, the import of bulk oil and other items calling for little, if any dock work, even when full regard has been paid to these factors comparison with earlier years makes it appear that some increase in productivity is taking place in the docks.

Referring to sanctioned strength, the report states that when the first half-yearly review was undertaken last April the trade outlook was particularly obscure. The improvement at the beginning of the year had not been maintained and it then seemed unlikely that developments would accelerate to any appreciable extent before the final quarter of the year.

Against this background the board considered that labour requirements would not vary significantly before the second half-yearly review, and in view also of the effect of annual holidays in reducing the men available, made only minor alterations in the sanctioned strength. In two areas employment was running counter to the general trend, however, and increased authorities were granted for Bristol and Severn, and Hull and Goole where the standstill order on recruitment, which had been in force for two years, was lifted.

In 13 other areas standstill orders were retained, but special arrangements were made for the restriction to be lifted at short

notice if it became apparent that, after recourse to available men—including non-registered labour in appropriate circumstances—a register was inadequate.

For some time now it has been the Board's normal practice to review the registers from month to month as a supplement to the customary half-yearly review, and as a result further adjustments were made in two areas. Employment was continuing at a high level in Bristol and Severn and the sanctioned strength was again increased; at Garston and Widnes the termination of the permanent night shift of cargo workers resulted in greater flexibility of the available labour force and subsequent events justified the board's decision to reduce the sanctioned strength.

The second half-yearly review was undertaken in December and the board noted, as already mentioned, that although there had been a slight improvement in the employment level it did not compare with the increase in the volume of trade officially recorded; furthermore the existing register was already carrying surplus labour of 11.3 per cent and there had been a steady drain on the board's finances.

It was, therefore, considered that the potential margin for recruitment of 3,395—the difference between the sanctioned strength and the actual strength of main and probationary registers—was unduly excessive, and accordingly the sanctioned strength was reduced from 74,277 to 72,280. This action did not entirely remove the scope for immediate recruitment as it still left a margin of 1,398 for meeting any sudden up-surge in labour demands.

The temporary release schemes adopted by 17 local boards in 1958 continued throughout last year, but there was only a small increase in the numbers of men on release—from 210 to 228. This was largely due to the limited opportunities for alternative employment in the areas concerned; it can also be expected that the number of men seeking release will in future steadily decline as registers are brought more closely in line with labour requirements.

The net reduction of the labour force last year amounted to 1,626 men and this figure was substantially less than the corresponding reduction recorded in 1958. Direct outflow was somewhat less than in 1958, no doubt because registers approximated more closely to current requirements. The principal factor limiting the net reduction of the registers during 1959, however, was recruitment in those areas in which improving conditions had justified increases in the registers.

To a greater extent than in the previous year, the need for recruitment in 1959 arose within those areas where local boards

National Dock Labour Board—continued

have adopted the principle of probationary service, and for this reason the average numbers of probationary registers increased from 470 in 1958 to 597 in 1959. Generally, however, less use was made of temporary and seasonal registers, their average being 277 men as against 338 the previous year.

Labour Shortages

Labour shortages during the year, expressed in man-days, exceeded those recorded in 1958 by approximately 45,000. This net increase was attributable almost entirely to industrial disputes in Liverpool during the last quarter—both on the docks and in ancillary occupations; in each case the interruption led to an accumulation of cargo work and consequent shortages of labour until the arrears had been cleared.

Such shortages are the inevitable aftermath of disputes, and in this case they tended to obscure a more permanent increase in traffic. By December, however, the effects of the disputes could be completely discounted and it became necessary for the Liverpool board to reinforce the register to meet the continuing heavy labour demands.

The sharp variations in demand responsible for the majority of labour shortages presented the board with a number of difficult decisions when reviewing the future labour needs of individual areas. Manchester provided a good illustration of the considerable fluctuations which can arise in one area in week-to-week and day-to-day requirements; in the absence of really firm information as to prospects for an individual port, such fluctuations can all too easily encourage either undue optimism or undue pessimism in assessing future labour requirements.

The figure of 39,322 man-days lost by disputes compares favourably with most of the years since the inception of the scheme, and is very much lower than the last two years. The time lost in 1959 was principally due to two unofficial disputes; one at Hull in June, involving 12,359 man-days when the men objected to the traditional scoop-and-basket method of unloading cotton seed, and the other at Liverpool in October, when 13,955 man-days were lost following a demand for higher rate of payment for the discharge of an allegedly dirty cargo.

Training Schemes

The need for training additional specialists was again reduced as a consequence of the relatively small number of new recruits to the registers, and under schemes financially supported by the board only 92 men were trained compared with 107 in 1958 and 297 in 1957. The total cost of £1,144 covered the training of checkers, crane drivers, bulk grain weighers and lighterage apprentices.

The general improvement at the end of the year, however, brought further applications from local boards for additional training which will affect the 1960 returns.

Average weekly gross earnings are shown in the report as £14 12s. 5d. compared with £13 13s. in 1958. It is emphasised that the figures are averages of a very wide range of differing degrees of activities as between ports and between the rates of remuneration for the various operations.

Finance

In considering its budget for 1959, the Board reckoned on an average level of employment and registers which was not substantially different from the actual experience described earlier. On that basis a deficit on management fund in the region of £60,000 was expected, and it was decided that, as such a deficit could safely be met from levy stabilisation fund, the rates of percentage payments introduced in November, 1958, should remain unchanged.

In reaching this decision the board could, of course, count on a substantial increase in its income because of the operation of the foregoing rates of levy for a full year on wages which had also

been increased in the previous September; and the accounts show that the enhanced revenue from this source—i.e. £5,434,138 compared with £4,799,652 in 1958—was the largest factor in the improved financial results.

On the other hand, there was an appreciable reduction in investment income both in respect of surpluses on realisation and on net interest which, in the main, reflects the inroads of nearly £1½ m. made into levy stabilisation fund during the three preceding years.

Nevertheless, after making the customary appropriation to general welfare fund at ½ per cent on the wages of all dock workers, and allowing for the allocation from investment income to meet education costs, the net income to management fund for 1959 at £5,263,606 was about £500,000 higher than the previous year.

Total operating costs, however, fell to £5,699,024—a reduction of nearly £300,000 of which about £30,000 related to capital expenditure. The maintenance of the board's welfare services cost some £14,000 more than in 1958, so that the net saving on operational and accounting costs amounted to some £284,000. Practically the whole of this sum is accounted for by reductions in expenditure directly related to the size of the labour force—notably on attendance money, guarantee make-up, holiday pay and National Insurance contributions; the further "trimming" of registers which the board was able to achieve during the year may thus be said to have made an important contribution to the better results.

New Premises

As forecast in previous Reports, the annual expenditure on new premises continued to fall as the initial building programme came nearer to completion. There was a substantial reduction on this occasion, due partly to the smaller sizes of the projects undertaken during the year, and the total expenditure of £126,000 compared with £204,000 in 1958 and £227,000 in 1957.

Work was completed on the erection of new call stands and offices at Liverpool ("B" area), Workington and North Shields, and on the modernisation of call stands at Hull (King George and Alexandra Docks) and Surrey Docks, London. At the end of the year work was proceeding on the erection of a new call stand and office at Blyth, and a shelter at Surrey Docks, London, for men waiting between calls; and modernisation schemes for the call stands at Birkenhead and Garston were nearing completion.

Modern Tanker Discharging Station in Open Sea

Small Artificial Island Installation

The development in recent years of the fuel oil industry has been responsible for many changes, not the least among these being the siting of the refineries. It is necessary for these to be on a main traffic route in or near some accessible port which in all respects is suitable for the rapid turnaround of the vessels. So long as the tanker did not exceed 12,000 tons deadweight, it was not difficult to satisfy these requirements but, with the growth in construction methods and size of tankers, many ports found that they had not the necessary installations to deal with them. Solutions had then to be found and new ideas tested to provide alternative berthing facilities.

One solution was to construct an artificial island in open sea to serve the purpose of a discharging station for the largest tankers. Two islands of this type have already been constructed and are now in operation in the Mediterranean, one at Ravenna on the Adriatic coast of Italy, and the other at Augusta on the

Tanker Discharging Station—continued

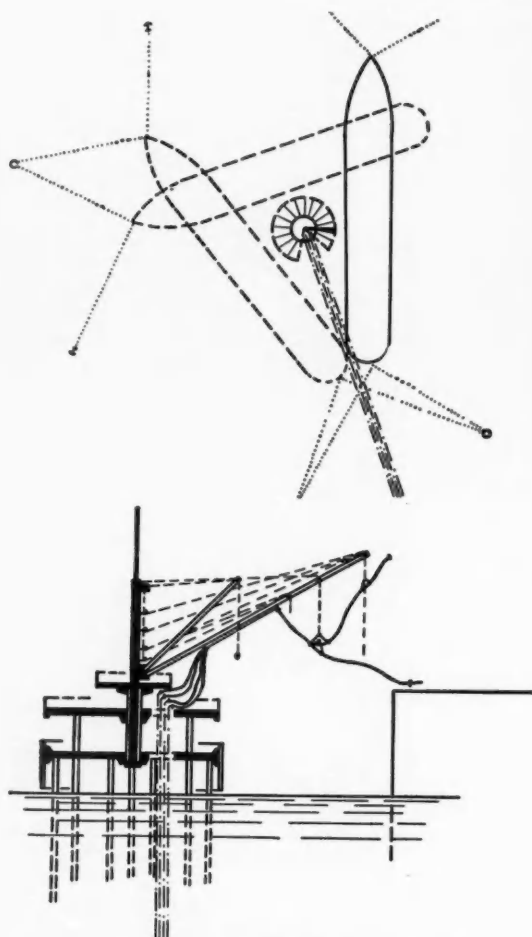


Fig. 1. Mooring Island off Ravenna.

east coast of Sicily.

The seaport of Ravenna lies in the delta of the river Po and its tributaries at the head of the Adriatic Sea, with no channel of importance for deep draught sea-going tankers visiting the Sarom refinery. After meticulous studies a solution was found to overcome the transport difficulties and it was decided to construct an island discharge station at moorings in the open sea, and a pipeline link between the vessel and the shore.

The island itself is erected on tubular steel piles in the form of a circular structure some 5 kilometres from the shoreline. It was originally intended for vessels of 32,000 tons displacement but this was later raised to deal with vessels of double the capacity in view of the strong trend of tanker shipowners to order new shipping of even larger dimensions. As work had already been commenced to the original lay-out, provision was made after the above decision to prepare for the removal of the island into deeper water about 6.5 kilometres from the shore if required.

At this distance from land it was not considered safe for the vessels to be moored alongside the island and a mooring technique was evolved. After considerable testing it was decided that there should be a gap of at least 20 metres between the ship and the island. This was arranged by placing the mooring buoys around the site firmly anchored in the sea bed as shown in Figs. 1 and 2. In quiet water the tanker may moor to buoys alongside the island whereas in bad weather it will moor to buoys with stern *à pic* to the island as illustrated Fig. 2, and full safe distance therefrom.

The connection of the island to the land refinery is by 16-in.



Fig. 2. Tanker moored to buoys, oriented *à pic* island.

diameter pipe for the crude and bunker oil and 8-in. diameter paraffin, gasoline and benzine. These are buried in the sea bed, strongly anchored and operated at 30 atmospheres for the larger size and 16 atmospheres for the smaller.

Between the island and the tanker the connecting pipes are of leather to provide the flexibility and strength. They are suspended over the gap from the jib of a crane which is capable of sweeping through a circular arc of 300 degrees; the remaining 60 degrees of the full circle is the portion blinded by the pipe line to the shore.

There is in addition to other equipment for the working of the crane a very necessary arrangement with a 26 metres high signal mast to which a suitable nautical flash-light, visible at 7 miles, is fitted. Included in the installation are ample stores for all contingencies, a lifeboat, fog-horn, fish net and fresh water etc.

The weight carrying structure of the lower platform comprises two steel plates (horizontal) spaced apart and joined by numerous stiffening ribs. The pile heads are sheathed with timber, whereby elastic displacement of the dolphin without bending can take place. The scaffold part is also treated in a similar manner.

The floor of the lower platform is covered by a lattice grating for a working load of 160 lbs. per square foot and is clear of the deck plate to allow the water to drain freely. The deck plate for this purpose has a slight inclination downwards towards the centre where an oil filter is installed.

The upper platform unlike the lower has only one thickness of deck plate with supporting girders underneath. This deck not only takes the working load of the upper platform but also the horizontal forces for all of the fixed crane columns over the four joined columns on the lower platform.

The dewatering of the lower deck is arranged so that it is collected in a channel and then fed into an oil filter before being discharged into the sea.

Since 1956, the island has experienced frequent storms without damage.

Errata

Our attention has been called to two unfortunate errors in the original manuscript supplied for the article on "Timbers for Marine Construction" which was printed in our May 1960 issue.

On page 25 at the bottom of the first column, the correct figure should read "Specialist firms will carry normal sizes, such as 9-in. x 9-in., 18-in. x 18-in. and up to 60-ft. in length."

In the Remarks column in Table 1 on page 26 the taper 1-in. to 20-in. should read "Very high resistance to marine borers. Taper on hewn does not exceed 1-in. in 20-ft. and surfaces sufficiently flat to allow easy fixing of waling and planking."

Book Reviews

Port Operation and Administration by A. H. J. Bown and C. A. Dove. 2nd edition, revised by E. S. Tooth. Published by Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. 354 pp. Price 45s.

The decade which has elapsed since the initial publication of this compendious work has been one of immense political and social change, of remarkable economic expansion in all fields, tempered only by the need to restrain it from outpacing the needs of a sustainable prosperity. The most disagreeable consequence has been the fall in the value of money. Capital reconstruction carried out since the war has produced an abundance of wharfinger facilities and, at the present time, a superfluity of ships. All of these represent large investments the proper return on which requires the handling of substantial tonnage. It is axiomatic that the more numerous the facilities available to handle a given traffic the scantier the portion each may enjoy. Inadequate facilities ward off traffic but it is not at all likely that commerce is enlarged by providing these in excess. In revising the first edition, Mr. Tooth is indeed conscious that the work of port operation today is being performed in a somewhat different climate than that which prevailed when the authors first embarked upon their weighty task and the emphasis now is mainly upon the necessity of finding newer and better ways of employing the facilities provided. Here again the sections added do not merely catalogue the range of labour aids which have come into service but lay stress upon the need for a sympathetic understanding of the human problems which are involved by their use.

The work was originally conceived as a textbook to provide students and young traffic supervisors with the essential groundwork of port operating procedure and to instil in them the discipline and habit of mind which will fit them for a professional career in their chosen calling. At the same time the subject is one which is little understood by the general public for, with the exception of passenger facilities, the service provided at ocean terminals and by sea transport is not a personal one although it is the essential link in the processes of commerce by which the world works and lives. There is much in the book, therefore, which should interest the general reader who wishes to be better informed in this direction. Regarded as a textbook, the first business of a teacher is to infect the student with his own enthusiasm for his subject and here the authors have been admirably successful.

Any attempt to deal comprehensively with a subject which has such scope and ramification must inevitably consist largely of factual information. In this case it concerns almost exclusively the custom and procedures long established in British ports without attempting to argue their merits in contrast with methods which find favour elsewhere, not only in port undertakings overseas but also in other industries. At a time when simplification and the elimination of redundant actions has never been more necessary, the section of the book describing administrative routines must surely provoke misgivings even allowing that a process however lucidly explained is invariably more complicated in the description than in the performance. There are, of course, lacunae. One might argue that a short conspectus of the origin, scope and purpose of the Carriage of Goods by Sea Acts and the Bill of Lading was indispensable in a book intended for the use of students, who would be well advised to familiarise themselves with Temperley's excellent commentary on the subject. Similarly, some appreciation also of the problems of the shipowner and of sea transport generally, so well portrayed in R. H. Thornton's "The Cargo Liner", is necessary for a balanced judgment on the subject as a whole, otherwise the student will not be altogether sure what it is all about and may be in some danger of developing into a mere "routineer". Port administration in its higher branches (for which the student must equip himself) calls for the clearest analytical minds, for in supplying the essential public relation in a sphere of predom-

antly private enterprise it is, in fact, a microcosm of government itself.

But these are small criticisms of a truly invaluable work. The problem of what to put in and what to leave out in such a context is an insoluble one and the book is to be warmly commended as a study of a massive subject hitherto never attempted comprehensively.

P.A.T.C.

Lloyd's Register of Shipping 1760-1960, by George Blake. Published by Lloyd's Register of Shipping, 71 Fenchurch St., London, E.C.3. Price £2 2s.

The bi-centenary of this oldest and largest ship classification society in the world was celebrated last month with a banquet in Guildhall, London. Also to commemorate the occasion, this book has been specially written for the Society by Mr. George Blake.

The method of underwriting marine insurance in London during the middle ages was very much as it is today. The merchant wishing to arrange the policy would go round the city seeking men known to be interested in this type of business who would indicate the portion of the risk they were prepared to shoulder by writing their names on the policy, one under the other, and so became known as underwriters. The difficulty was that the merchant or shipowner had to search the city in order to find sufficient underwriters to cover the value of ship and cargo but the coffee houses which were making their appearance in London during the 17th century soon became popular as an informal meeting place for men interested in that particular line and a considerable amount of business could be conducted under the one roof. One of these coffee houses was the establishment conducted by Mr. Edward Lloyd in Tower Street, London.

The earliest known reference to Lloyd's Coffee House was an advertisement in the London Gazette of 18th February, 1688. In 1692 the establishment was moved to Lombard Street in the centre of London's commercial area.

In 1760 a group of customers decided to start a reference book for their own use. This book was to contain details about all ships trading to and from ports in Great Britain, and the committee appointed inspectors at the principal ports to survey ships and report their characteristics to London. Many of the coffee house clientele were interested in underwriting, then more of a gamble than a business venture and the new register was designed to provide all they needed to know about a ship, including a system of coding to show the condition of the hull and equipment. The prime condition subsequently became known to everyone as "Al at Lloyd's".

Today, the surveyors of Lloyd's Register of Shipping are to be found in all the major ports of the world, as well as in shipyards and engineering centres; the staff of its Land Division is engaged in nuclear power projects, oilfields and many other undertakings where technical experience and advice are required.

An account of the activities of Lloyd's Register in the intervening 200 years would in itself provide little more than a treatise for specialist students of ship classification; but Mr. Blake has reached beyond the minutiae of official records by tracing the international development of the society side by side with the growth of merchant navies throughout the world.

In its early years the small society was concerned only with its underwriting interests in local trade, and it was not until shipowners began building ships to the coveted "Al" standard, that Lloyd's Register was re-formed as a technical body and rules for the guidance of shipbuilders were established.

Requests for the services of Lloyd's Register surveyors soon began to come from shipbuilders and ship-owners in sea-trading countries, and to quote Mr. Blake "the history of Lloyd's Register faithfully mirrors the trends in world shipbuilding over a long period of time". Not only have the numbers of technical

personnel grown to meet the many demands but National Committees have been set up in the leading shipbuilding countries.

Throughout his book, Mr. Blake calls attention to the international standing and outlook of Lloyd's Register. Its care is simply for those, without politics, without nationalism, described in the Psalm—"They that go down to the sea in ships, that do business in great waters"—words which are inscribed on the walls of the Committee Room in London.

The humanist in George Blake could never overlook the personalities who appear from time to time in an organism of this nature, and his tales about some of the dignitaries concerned introduce a characteristic note of realism, and humour, to his story of the Society's achievements in peace and war.

The book contains photographs of some interesting historical relics, a number of drawings in line and wash by David Knight, and a colour plate of the Arms granted to Lloyd's Register of Shipping in 1958.

The Deep Sea Tramp, by Capt. A. G. Course. Published by Hollis and Carter, 25 Ashley Place, London, S.W.1. Demy Octavo 280 pp 26 illustrations. Price 21s. net.

Britain's continuing greatness as a trading nation and her survival in two world wars owes an incalculable debt to the Merchant Navy and especially to the masters and crews of the tramp steamers who have maintained for over a century, often in the face of incredible hardship and danger, the flow of goods on which Britain's life depends.

This book is about these men, the ships they serve in, the goods they carry. It is the first full-scale account to be written for many years and it is unique in that it is written by one of their number who first went to sea in a square rigger at the age of fifteen.

Beginning with introductory chapters defining the tramp as it has been known for the past century and tracing its evolution from the Roman tramps which plied the Mediterranean to the Universal Bulk Carrier of today, Captain Course goes on to survey the tramp trade in its entirety.

He is a lucid guide to the difference between voyage and time charters, to dead freight, demurrage, "general average" and "particular average" and the conventions which have governed the trade from the mediaeval Rules of Oléron introduced to this country by Richard Coeur de Lion to the York-Antwerp Rules last revised in 1950.

Supplemented by his own experience and first-hand accounts by the men who sailed in them Captain Course also describes the different types of ship—whalebacks, archdecked, arcform, trunks and the modern shelter-decked vessels—which have been developed in the quest for the perfect cargo vessel.

Much of the credit for this research must go to the great British shipping lines, most of them established since the early years of the nineteenth century, which are described in full from their origins to the present day as are the men who have served them so long and so well in their ships, for Captain Course's account of the deep sea tramp is firmly based, like all compelling history, on human actions and motives.

New Tanker Cleaning Installation

A tanker cleaning installation incorporating a jetty, mooring dolphins and associated shore works is being built on the west bank of the River Mersey at Rock Ferry, Birkenhead, by Sir Alfred McAlpine and Son, Limited. The purpose of this project is to permit tankers to berth so that their tanks can be cleaned by a patented process before entering neighbouring dry docks for repair.

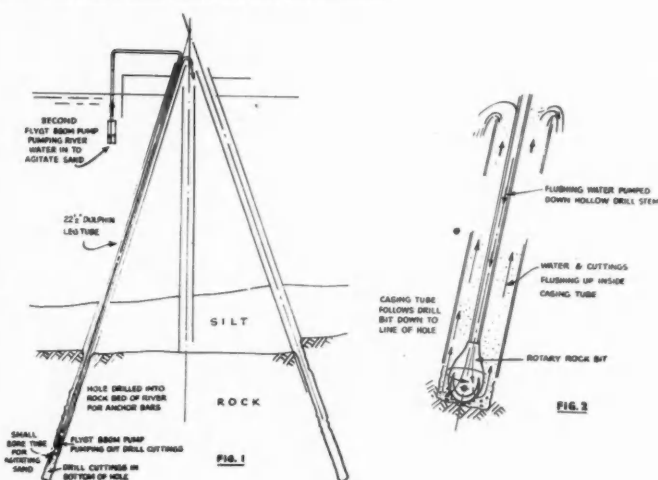
The jetty construction is being carried out in the following stages:

- 1 **Approach jetty:** Steel lattice girders supported on steel tubes which are drilled into the rock bed of the river.
- 2 **Jetty head:** Tubular steel structures supported on colloiddally grouted concrete foundations of the river bed.
- 3 **Mooring dolphins:** Steel tripod structures consisting of three heavy steel tubes sealed into holes drilled in the river bed, braced together and stressed down by high-tensile steel bars which are grouted into holes drilled into the rock beneath the tubular legs. The tripod has a bollard on it to take the mooring ropes of a tanker.

Flygt Electrical Submersible Pumps have been used for cleaning the drill cuttings out of the holes drilled into the rock prior to inserting the tubes and high-tensile steel bars.

The tubes down which the pumps are lowered are 22½-in. in diameter, varying from 60-80-ft. long, and the holes below the tube into the rock are 17¼-in. in diameter, and from 25-30-ft. deep. The cuttings are ground up red sandstone rock and the principal reasons for selecting the Flygt pumps were, firstly, their compact dimensions which allowed them to be dropped down the tubes, and secondly, their ability to handle water containing solids of up to 3/16-in. in size.

The only trouble experienced in pumping was that, if the cuttings settled in the bottom of the hole, they formed a fairly solid packed base which made pumping difficult. This was overcome by injecting water down a small-diameter tube inserted to the bottom of the hole, using a second pump to agitate the sand and dilute the percentage of solids (Fig. 1).



In addition, Flygt pumps have also been used to remove cement grout from the holes in the rock after it has been injected during operations to render the holes watertight.

As already mentioned, these pumps have been used to supply flushing water to a rotary rock drill, which is similar to the type used in exploratory boring. This is fitted with a rotary bit to crush the rock into reasonably fine cuttings in the form of coarse sand. So as to keep the drill free running and to flush the cuttings out of the hole in the rock, water is pumped down the hollow drill stem and out through nozzles in the bit. The cuttings are flushed up inside the casing tube, inside of which the drill is operating (Fig. 2). The normal type of diesel-driven centrifugal pump used with this drill cannot in this case be used since the drill is mounted on a structure standing some 40-ft. above the tide level at low water, thus exceeding the suction capacity of the pump.

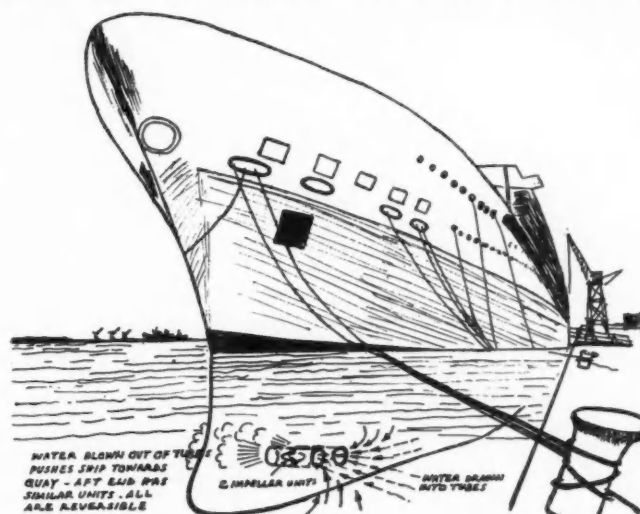
The works are being carried out for Messrs. Cammell Laird & Company, (Shipbuilders and Engineers) Limited, the Consulting Engineers being Messrs. Rendel, Palmer and Tritton.

Sideways Manoeuvring Units in New Liner

When it was first announced by the builders, Vickers-Armstrongs, that the new 40,000 ton liner *ORIANA* for the Orient Line, would be able to move sideways much interest was aroused. Now more information is available about this important development. The transverse propulsion units have already been fitted in "*Oriana*", now fitting out at Barrow for completion in the autumn. She was launched last November by H.R.H. Princess Alexandra.

The principle of moving a ship sideways is not new. Such devices as the Pleuger activated rudder, the bow rudder and the Voith Schneider propulsion system have been known for many years in one form or another, and there is more than one ferry boat with Voith Schneider propellers at bow and stern which can be claimed to be manoeuvrable in all directions. "*Oriana*" will be the first big ship to adopt the principle as a major auxiliary installation.

The transverse propulsion units in "*Oriana*" are not similar to any of the above types. Each unit comprises an electrically driven impeller designed and constructed by Vickers-Armstrongs (Engineers) Ltd. on the lines of their well-known axial flow pump installation. The impeller is carried in a horizontal streamlined casing, with geared drive at right angles to the impeller shaft. The impeller casing with its drive is mounted in a cylindrical tube fitted athwartships at some distance below the light waterline. The tube was designed so that it can be split in way of the impeller unit which is mounted on the portable section of the tube; the whole can therefore be removed from the fixed part of the tube for



servicing. On each side of the section containing the unit, the tube continues as a cylindrical nozzle, terminating near the shell opening. A grating is fitted at the end of the tube to prevent entry of drift wood or large debris.

The principle of operation is similar to that of a jet, but since the optimum efficiency of such a system occurs when the speed of the propelled vessel is half that of the jet and in this case the ship's speed always can be considered as almost zero, then the thrust obtained is an optimum when the mass flow is a maximum with the corresponding lowest practicable velocity. This has been achieved in the case of the "*Oriana*" by providing a tube and impeller of large diameter, running at comparatively slow speed, and therefore the installation has a higher efficiency than other types of device.

The actual operation consists in drawing in water through the shell opening in one side of the ship and expelling it through the opposite opening (see illustration). Direction is reversed by simply

reversing the impeller motor. The installation in "*Oriana*" comprises a total of four separate units, two forward and two aft. Each unit is under separate remote control from each of three consoles on the Navigating bridge, one in the centre and one in each wing, and by operating any combination of 1 to 4 units, a degree of control not previously possible is achieved.

Berthing a large ship is seldom a simple matter and, with a combination of cross wind and current, can be awkward and sometimes damaging, even with the assistance of tugs, capstans and fenders. Dry docking and manoeuvring in small harbours or winding channels can be no less hazardous. The transverse propulsion units in "*Oriana*" will largely offset such hazards.

It is also possible to turn the ship completely round using the transverse propulsion units. With the manoeuvring units operating, say 2 forward to port and 2 aft to starboard, "*Oriana*" will be able to turn right round without using the main engines.

Openings in the shell tend to increase the resistance of the hull when a ship is proceeding on a normal course. This is not of great importance in special craft such as dredgers and river ferries where speed is low or the run is short. "*Oriana*" is a fast ship on long leg voyages and hence any increase in hull resistance must be avoided as far as possible; the shell openings are therefore provided with steel doors, the outer surface of which is fairly accurately to the contour of the hull. The doors are of ribbed box section and operated by electric motors with local manual control. The position of the doors, open or closed, is indicated electrically at the central bridge console and interlock units prevent the impellers being started unless the doors are fully open.

One of the principal advantages of an installation which is directly under the control of officers on the Bridge, is the instantaneous response obtainable for checking quickly any undesired rotation of the vessel. This is in contrast to the often considerable delay which occurs when instructions have to be passed from the Bridge to operators ashore or to tugs.

Manufacturers' Announcements

Radar for the River Rhine

The new Decca River Radar type 215 was introduced on the Rhine at Rotterdam and Duisburg at the end of last year and instructions to fit over 75 vessels have already been received from the Continent of Europe. In addition, the equipment has been specified by Canadian and American shipowners for use on the Great Lakes and in harbours and on the inland waterways of the United States of America.

In 1956, after a very full study of the problems involved, the Company pioneered the use of river radar on the Rhine with the type 214 specifically designed to fulfil the very exacting requirements of inland waterway navigation. In the course of this development, trials were carried out on the river Rhine for a period of one year on board the Swiss vessel "*Valcava*" to be quite certain of the performance standards and operational facilities necessary. Despite the difficulties of introducing an entirely new concept into inland waterway navigation, this radar was most successful and nearly 300 vessels were equipped. Until the advent of radar, Rhine navigation remained virtually unchanged since cargo carriers first plied its waters: all ships stopped at night and in poor visibility with the consequent losses of economy involved. The success of the early fitted vessels aroused wide-spread interest and the Rhine Central Commission progressively introduced the improvements necessary for radar navigation. These included radar buoys, radar reflectors, the marking of difficult channels, groins and bridge piers.

River Radar is a specialised field and no simple modification to a normal marine radar can produce a satisfactory equipment. The Decca 215 is characterised by the outstanding accuracy and clarity of its 23 cm. radar screen. A new large scale of 400 metres

Manufacturers' Announcements—continued

radius is provided. This is the first of seven closely spaced range scales which permit the smooth progressive movement from one scale to the next, essential for inland waterway navigation. On each scale the position of own vessel can be off-centred by half a radius giving nearly double forward look out.

A special magnifier, with a ratio of 1.7 to 1, is also provided giving a radar presentation of almost double size with outstanding picture quality on all scales. Other technical features include a choice of two carefully selected pulse lengths, a new aerial of high bearing discrimination with low side lobe level and a new control for variable differentiation. This control, introduced for the first time in marine radar, enables the operator to adjust the degree of differentiation applied to the radar signals in order to display a consistently sharp radar picture under all the varying physical conditions which occur in different sections of the inland waterways.

Submersible Pontoon Crane

A15/25-ton 4-motor Pontoon Crane has been designed and manufactured by Butters Bros. and Co. Ltd., Glasgow for the Escravos Bar Contract, which is at present under construction by Richard Costain/Raymond International (U.K.).

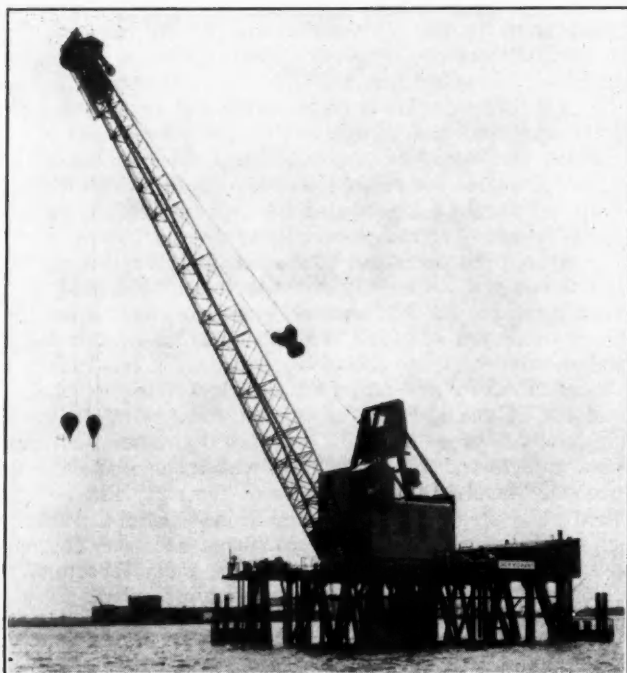
The crane has separate motors for each of the hoisting, tipping, luffing and sluing motions. Each motor is controlled by a separate master type controller with a dual control interlock between the hoisting and tipping. The operator is positioned in a compartment situated well forward in an elevated position.

The load ratings for the crane on 4-parts rope are as follows:- 25-tons at 80-ft. radius, 20-tons at 95-ft. radius, 17-tons at 110-ft. radius and 15-tons at 120-ft. radius on 2-parts rope.

The tipping hook is capable of handling a load of 15-tons up to a maximum radius of 120-ft. with a jib 130-ft. long.

The speeds of operation are as follows:-

Hoisting (4-parts rope)	25-tons at	40-ft./Minute
Hoisting (2-parts rope)	15-tons at	80-ft./Minute
Tipping	15-tons at	80-ft./Minute
Sluing	25-tons at	400-ft./Minute
Luffing	25-tons at	30-ft./Minute



Submersible Pontoon Crane.

The crane is fitted with two 125 h.p. motors for the hoisting and tipping motions, a 70 h.p. motor on the luffing motion and a 55 h.p. motor on the sluing motion. The current supply is 400 volts D.C. with a 110 volts supply for lighting. Contactor control gear and limit switches are fitted and the control circuit is arranged to give inching on all motions. Suitable lighting is supplied throughout. Electro-mechanical brakes are also fitted on all motions and the current is led in through a slip ring collector column which is fitted above the centre column of the crane.

The all welded superstructure is of the latest design and revolves round the mild steel centre-post and supports the jib, ballast tank, hoisting, tipping, luffing and sluing motions and revolves on live ring rollers. The jib is of the latticed type and is 130-ft. long, centre to centre, to enable the crane to carry the loads at the specified radii.

The combined roller path and sluing rack is formed by a rolled steel circular girder which is fixed to the top of the sole-plate. The high tensile steel pins forming the rack teeth are securely locked in the circular girder and made easily removable for maintenance purposes. The path for the sluing rollers is made of mild steel flats machined to suit the taper of the rollers and is fixed to the top of the circular girder.

The crane was erected under the Company's supervision in the shipyard in Rotterdam and was fully tested there. It was mounted on the pontoon prior to sinking on to the sea bed.

This submersible pontoon forms a major part of the plant and equipment which has to be used on the Escravos Bar Construction. The complete unit has to be towed out to Escravos and there the pontoon will be submerged in various positions between one and six miles out to sea.

Four other new cranes have been or are being manufactured by Messrs. Butters Bros. and Co. Limited for this particular contract; two 15-ton 3-motor Electric Derrick Cranes with 120-ft. jibs are already on site and two 15-ton Goliath Cranes with a cantilever projection for mounting on barges, are at present being manufactured.

Welded Aluminium Alloy Hatchboards

In May 1958, Saro (Anglesey) Ltd. of Beaumaris, Anglesey supplied to the m.v. "Enugu Palm" of the Palm Line Ltd., a total of 434 welded aluminium hatchboards for the five upper deck hatches. Recently the hatchboards were inspected after their 2 years service, and, in spite of the continuous and arduous service to which the boards had been subjected, there was no sign of weld or other failure, nor was there any sign of corrosion.

The carrying of hardwood logs and sawn timbers as deck cargo is common practice; the logs remain in this position during shipment to the United Kingdom and the weight of the deck cargo on these hatches is estimated at between 50 and 60 tons. It is considered that it would have been necessary to replace up to 50% of equivalent timber boards over the two year period. To date however, none of the aluminium boards have required replacement, and another advantage is their light weight and smooth under surface which enables them to be slid easily into position and to be carried by one man. This is particularly useful during the rainy season in tropical climates, where, to protect the cargo in the holds from frequent showers, the boards may have to be moved on and off the hatches as much as twelve times a day. An additional factor in the use of aluminium hatchboards, which are only about 1/3rd the weight of a standard wet timber board, is the considerable reduction in top weight.

This Company supplies positive buoyancy, welded aluminium alloy hatchboards up to 8-ft. in length. The boards have received the approval of Lloyd's Register of Shipping and carry the Company's five year guarantee against corrosion under operating conditions.

Suction Dredger for Fleetwood Docks

British Transport Docks have placed an order with Simons-Lobnitz of Renfrew for the construction of a diesel-electric suction dredger for use in the dredging of the approach channel to Fleetwood Docks. This vessel will have a length B.P. of 180-ft., a breadth moulded of 38½-ft., a depth moulded of 17¼-ft. and a hopper capacity of 850 cu. yds.

The primary power units of this dredger, which will be a twin side pipe trailing hopper type, will be two Mirreles JLSM8 diesel engines coupled to generators supplied by the Brush Electrical Engineering Co. Ltd., who will also provide the control gear and the propulsion and pump motors. All dredging operations will be controlled entirely from the bridge. A Voith Sneider propeller will be fitted in the bow to assist in maintaining course when dredging.

Submarine Cable for Maldive Islands

During the past year construction work has been in progress on the R.A.F. staging post on Gan Island in the Addu Atoll of the Maldive archipelago. At the same time a radio station has been built on Hittadu Island to the North West of the Atoll and a submarine cable was laid to carry the necessary power from Gan for the operation of the radio station. The installation of the submarine cable was preferred since the alternative of laying land cables across the intervening islands of Fedu and Maradu entailed not only a longer route, but extensive excavation and short underwater crossings between the islands.

British Insulated Callender's Cables Ltd., who have wide experience in submarine power cable work throughout the world, manufactured and installed the cables in conjunction with Drake and Gorham (Contractors) Ltd. who were responsible for the entire electrical installation.

A total length of 13,000 yards of 3-core, 0.10 square inch 11 kV paper insulated, M.I.N.D., lead sheathed cable were laid. Precautions were taken against attacks on the lead sheath of the cable by the teredo worm, which is found in the warm waters of the Indian Ocean, by providing a bronze/copper tape overlapping the lead sheath.

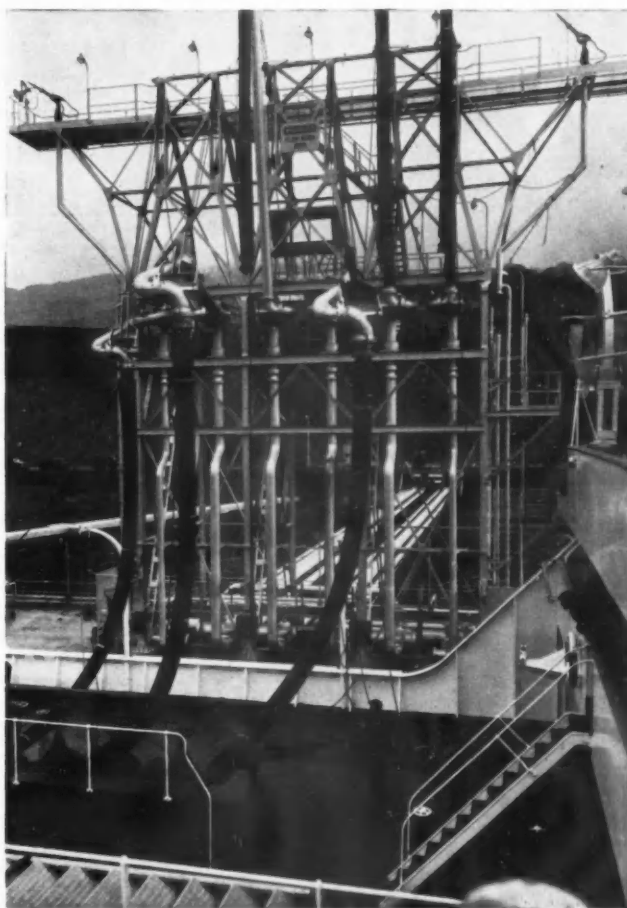
Flow Boom Equipment at Tranmere

In order to provide a deep water terminal for the berthing of large crude oil carriers in the 65,000 ton class, Shell Refining Company and the Mersey Docks and Harbour Board together have just completed a new installation which includes two jetties of original design, upon which are installed two Woodfield Flow Boom structures. This modern terminal will handle part of the crude oil intake for the Shell Refinery at Stanlow, Cheshire.

The jetty decklevel fixed at 27-ft. above H.W.L. and a tide of 30-ft. together with the variation in tanker tonnage to be discharged on these jetties presented many unusual difficulties in designing equipment for the control of the 12-in. flexible discharge hoses. However, the inherent flexibility of Woodfield Flow Booms has allowed every operating condition to be catered for.

The Woodfield Flow Boom System has been developed to meet the necessity of using increased diameter ship-to-shore pipe lines and is now installed at many of the World's larger Tanker Terminals. The resulting ease of manipulation and preservation of the rubber hose from damage have been major factors in the success of this equipment. Push-button control of Flow Booms, as at Tranmere, is effected by an operator situated either at jetty level or high in the structure providing a good view of the tanker manifolds.

Booms slew through an arc of 150° and can be luffed through 144°. The unique Boomhead Swivel increases the life of Hose which is not less than 12-15,000,000-tons in the case of 12-in.



Front view of Woodfield six-unit Flow Boom Equipment.

hose. By combining the use of Hose and Steel Tubular Booms a more reliable and safer method is achieved.

Woodfield are in a position to supply pneumatic or Hydraulic units, complete if necessary with remote control. Emergency winching gear, hand-operated is incorporated into the design in case of power failure. General Maintenance is reduced to a minimum by the use of seals which can be replaced without dismantling the Booms. It can be seen that the free slewing motion is an advantage should the tanker drift along the berthing line.

The Woodfield Flow Boom System will accommodate tankers from 2,000 D.W.T. to 105,000 D.W.T. capacity, allowing for a manifold rise and fall of up to 85-ft. according to Site conditions.

Two Tugs for British Waterways

Two Diesel Tugs ordered by the North Eastern Division of British Waterways are due to be completed this month at the Thorne Yard of Richard Dunston Ltd.

The "Brodsworth" and "Kellingley" are of a special design developed for the towing of compartment boats between Goole and collieries situated adjacent to the inland waterways of the North Eastern Division. Each compartment boat has a capacity of 40 tons. A normal tow comprises 19 boats. The tugs are 48-ft. 2-in. overall x 14-ft. 6-in mld. breadth x 8-ft. 10-in. mld. depth. Accommodation for the 4 crew is arranged in a cabin below deck forward. The propelling machinery is supplied by Lister Blackstone Marine and is fitted with an M.W.D. 3:1 reverse reduction gearbox.

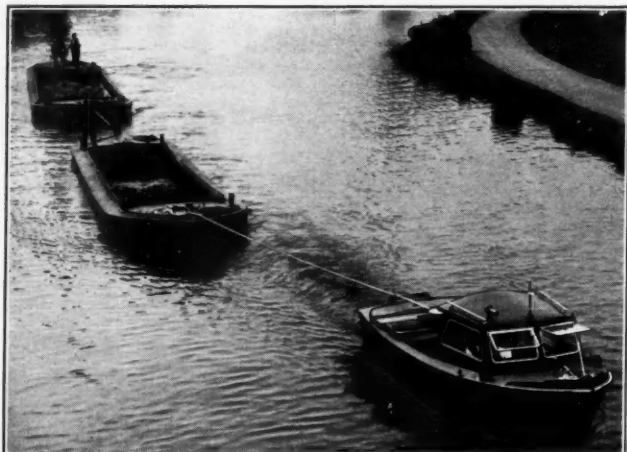
Manufacturers Announcements—continued

Launch Tug for Thames Conservancy

Trials were successfully completed last month on the second of two 25-ft. steel launch tugs constructed by W. R. Cunis Ltd. of Woolwich to the design of C. V. Hughes and Partners to the requirements of the Thames Conservancy. They will be based respectively at Reading and Sunbury for general purpose duties including towing and carrying men and equipment.

Of the hard chine type 8-ft. 6-in. beam and 3-ft. 6-in. draft aft they are of all welded construction of 3/16-in. plate with 2-in. x 2-in. x 1/4-in. side frames and 3/16-in. flanged bottom frames both spaced 18-in. apart. The stem is 5-in. x 3/4-in. bulbed plate. Extending the full length of the fore deck, the fore peak has a very useful storage capacity to which access is obtained through double hinged doors in the forward bulkhead.

Immediately aft of this is the steering position enclosed in a semi-portable wheelhouse. This is arranged for removal as there may be times when the vessels may be required to pass under bridges having restricted headroom. The after end is open but



Launch-tug towing barges on the Thames.

a roll up type canvas screen can be lowered to floor level when required. Two large windows of indestructible flexible celluloid are embodied in the screen which gives the steersman good visibility when looking aft when the screen is down.

An instrument panel containing a tachometer and the usual gauges and switches is fitted immediately in front of the steering wheel while immediately to starboard is the Thornycroft single lever remote control head which enables one lever to control both the reverse gear and engine speed.

The vessel is fitted with a fresh water cooled six cylinder 55/65 s.h.p. diesel engine fitted with oil operated reverse gear and 3-1 reducing gear, supplied by John I. Thornycroft Ltd., London.

Aft of the engine is a substantial tubular steel towing post and two 55 gallon fuel tanks are fitted one on each side of a spacious cockpit. The aft peak houses the rudder gear and an emergency portable hand tiller can be shipped if desired.

Trials of the first boat were carried out on the Thames at Reading by the Thames Conservancy when the following performance was obtained towing bow headed type barges over a measured half statute mile course:—

When towing one barge of 70 tons displacement at a maximum engine speed of 1,850 R.P.M. With the stream 5.73 m.p.h.; against the stream 4.55 m.p.h. Mean 5.14 m.p.h.

Towing two barges in line, gross weight 170 tons at a maximum engine speed of 1,800 R.P.M. With the stream 4.91 m.p.h.; against the stream 3.71 m.p.h. Mean 4.31 m.p.h.

A static bollard pull of 17-cwt. was obtained.

On its way from Woolwich to Reading the second boat was run over the Chelsea course at full power when a mean speed of 8 1/4 knots was obtained. As the boats will operate in confined water manoeuvrability is of importance and the turning circle at full speed is 2-2 1/2 boat's lengths.

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WANTED FOR NIGERIA—Second-hand Diesel River Tug, Steel Hull, Single/Twin Screw, max. 150 b.h.p., max. draught 6-ft., 4/5 native crew. Box No. 233, "The Dock and Harbour Authority," 19 Harcourt Street, London, W.1.

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SUBSTANTIAL QUANTITIES of anchor and mooring stud link and short link chain available. Sizes 1-in. to 3-in. Also stock and stockless anchors from 10-cwt. to 5 tons, with shackles of all types. **J. H. Lee and Son**, Chain Manufacturers, High Street, Nelson. Telephone: Nelson (Glam) 214.

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The Manchester Ship Canal Company invite applications for the appointment of Assistant Civil Engineers on the established staff of the Chief Engineer. Scale of salaries £845 at age 25, rising by annual increments to £1,310 at 38 with prospects of promotion to higher grades at salaries up to £1,795.

Candidates should be Corporate Members of the Institution of Civil Engineers or hold equivalent qualifications, and should have experience in design, specifications, construction and maintenance of Civil Engineering works. Harbour and dock experience is preferable but not essential. Successful applicants will require to become members of the Company's Contributory Superannuation Scheme.

Applications, stating age, qualifications and experience, should be addressed to the Chief Engineer, The Manchester Ship Canal Company, Ship Canal House, King Street, Manchester, 2, not later than 30th June, 1960.

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